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A Semimonthly Publication of the National Aeronautics and Space Administration

October 23, 1964

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Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-27894* Maryland U., College Park
COMPUTER ORIENTED RESEARCH IN THE SPACE RELATED SCIENCES Semi-Annual Status Report No. 11 Mar.–Sep. 1963
W. C. Rheinboldt [1963] 27 p refs
(Grant NsG-398)
(NASA-CR-58180) OTS: $2.60 ph

A research program to stimulate and broaden the effective use of modern large-scale, high-speed computers in space-research efforts, and to investigate new methods of computer applications in these fields is discussed. Work on the computer-oriented phases of the following research projects, is discussed in detail: (1) numerical mathematics—Chebyshev approximations for elementary and special functions, numerical analysis in modular arithmetic computers, computer applications to group theory, and investigations in logic and number theory using a computer; (2) chemistry—crystallographic structure determination by computers; (3) molecular physics—computation of vibration–rotation matrix elements for diatomic molecules; (4) physics and astronomy—computer-program development in long wavelength radio astronomy, and computational methods in nuclear physics; and (5) chemical engineering—investigation of complex equilibrium stage processes and computer modeling of two-phase flow problems. P.V.E.

N64-28008 Joint Publications Research Service, Washington, D.C.
GENERAL MEETING OF THE ACADEMY OF SCIENCES USSR
9 Jul. 143 p, refs Transl. into ENGLISH from Vestnik Akad. Nauk USSR, no. 3, 1964 p 3–4, 5–90, 122–123, 127–130, 141–147
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N64-28433 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 105
25 Aug. 1964 78 p refs Transl. into ENGLISH of 16 articles from K'o-hsueh T'ung-pao (Peking), no. 6, Jun. 1964 p 471–481, 510–514, 542–547, 551–563
(JPRS-26128; TT-64-41388) OTS: $3.00

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N64-28435 Joint Publications Research Service, Washington, D.C.
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4 Aug. 1964 249 p refs Transl. into ENGLISH from the Russian Periodical
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N64-28451 Lockheed Missiles and Space Co., Sunnyvale, Calif.
CREATIVITY, INNOVATION, AND INVENTION: AN ANNOTATED BIBLIOGRAPHY
George R. Evans and Peter R. Stromer, comp. Aug. 1964 18 p

The recent business management literature has been surveyed to assess the current trends and developments in the field of creativity, innovation, and invention. The literature reveals that some tentative yardsticks are now available to identify creative talent and the means for optimizing its usage in industry. The importance of innovation and its successful implementation by both the military and the aerospace industry is stressed as companies seek to adapt their work force and facilities to new markets. Author

N64-28469 Joint Publications Research Service, Washington, D.C.
ENGINEERING JOURNAL, NO. 2, 1963
A. A. Nikol'skiy, ed. 20 Aug. 1964 393 p refs Transl. into ENGLISH from Inzhenernyy Zhurnal (Moscow), v. 3, no. 2, 1963 p 202–416
(JPRS-26019; TT-64-41289) OTS: $7.00

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27. A COMPOSITE PROBLEM OF THEORY OF ELASTICITY FOR A LAYER A. F. Khrustalev p 348–353 refs (See N64-28494 20-33)

28. STRESSES AND DEFORMATIONS OF A PLATE MOUNTED ON A DEFORMED FOUNDATION A. G. Bulavko p 354–363 refs (See N64-28495 20-33)

29. BENDING OF A PLATE ON A COMBINED BASE V. S. Koltsov p 364–373 refs (See N64-28496 20-33)

30. PRESSURE FIELD DURING DIFFRACTION ABOUT A TRUNCATED WEDGE ZONE AND A HALF-INFINITE STRIP D. Ye. Levit p 374–382 refs (See N64-28497 20-33)

31. CREEP OF NON-FERROUS METALS AT ROOM TEMPERATURE BEYOND ELASTIC LIMITS A. M. Zhukov p 383–390 refs (See N64-28498 20-33)

32. CREEP AND DURABLE STRENGTH UNDER COMBINED TENSILE AND TORSIONAL STRESS V. P. Sdobyrev p 391–396 refs (See N64-28499 20-33)

N64-28676 Luigi Bocconi Commercial U., Milan (Italy)
METHOD FOR THE CHOICE OF TESTS [UN METODO PER LA SELEZIONE DEI "TESTS"]
W. De Ambrogio Brussels, Euratom, Jun. 1964 30 p refs In ITALIAN; ENGLISH Summary
(Contract Euratom-015-61-5-CETI)
(EUR-1824.I) Available from Belg. Am. Bank and Trust Co. N.Y., Account No. 22.186: 50 Belg. Fr.

The suitability of carrying out a certain test entails the comparison of the cost of the test and the amount of information that it furnishes. In this work, the principal factor analysis is used as a point of departure for determining the quantity of information furnished by each test. To accomplish this, the factors that give nonsignificant results were eliminated; an estimate of communalities was made; the relations $Z_j = a_{j1} F_1 + a_{j2} F_2 + \ldots + a_{jm} F_m$ $(j = 1, 2, \ldots, n)$ and, in turn, $F_s = b_{s1} Z_1 + b_{s2} Z_2 + \ldots + b_{sn} Z_n$ $(s = 1, 2, \ldots, m)$ were arrived at. The product $(a_{js} b_{sj})$ measures the importance of the variable Z_j as a determiner of F_s. The expression $Q_j = \sum_{s=1}^{m} a_{js} b_{sj} A_s/n$ (where A_s is the total contribution of the factor F_s) is a measure of the quantity of information furnished by a certain variable. Author

N64-28728 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 94
Fang Cheng-san et al 29 Jun. 1964 87 p refs Transl. into ENGLISH from Chinese Periodicals
(JPRS-25267; TT-64-31565) OTS: $2.25

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5. METABOLISM OF RNA IN THE SILK GLAND TISSUE OF THE CASTOR SILK-WORM Lu Chia-lung, Ku Chien-jen, Wang P'ei-yu, and Chu Ying-shu p 52–58 refs

6. THE INTERACTION OF NOREPINEPHRINE AND CHLORPROMAZINE Hsia Ping-nan, Chou Wen-cheng, Chu Chieh-yun, and Ch'eng Ts'ai-fen p 59–63 refs

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8. FIRST ANNUAL ALL-CHINA HEAT TREATMENT CONFERENCE CONVENED BY THE CHINA MECHANICAL ENGINEERING SOCIETY Mei Tsai-ch'uan p 67–69

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10. WORKING CONFERENCE ON ECONOMIC OPERATION OF POWER SYSTEMS AND AUTOMATION TECHNIQUES Wan Yu-liang p 74–75

11. CHINA ARCHITECTURE SOCIETY 1963 CONFERENCE P'u Hua p 76–80

N64-28816 RAND Corp., Santa Monica, Calif.
THE USEFULNESS OF AEROSPACE MANAGEMENT TECHNIQUES IN OTHER SECTORS OF THE ECONOMY
Thomas K. Glennan, Jr. Jun. 1964 9 p Presented at the NASA-UCLA Symp. and Workshop on the Transformation of Knowledge and its Utilization, Los Angeles, 2 Jun. 1964
(P-2921; AD-601619)

The managerial techniques used in the aerospace industries have been shaped by the unique conditions surrounding these industries. The demands of their most important customer (the Government), the frequent combination of large state-of-the-art advances with great development urgency, and the large size of many projects have combined to shape management techniques and systems. It is suggested that these techniques cannot be translated or transferred into other industries without extensive modifications, and yet many similar qualities to processes, which appear in other industries, exist. Thus, a selective utilization of some parts of the managerial techniques is likely to have a very profound effect upon other industries. It is up to the managers of industries to seek out those components of the aerospace managerial systems that make sense to them. I.v.L.

N64-28850* National Aeronautics and Space Administration, Washington, D.C.
ADDRESS BY JAMES E. WEBB, ADMINISTRATOR, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, MIDWEST GOVERNORS' CONFERENCE, MINNEAPOLIS, MINNESOTA, SEPTEMBER 10, 1964 News Release
James E. Webb 10 Sep. 1964 11 p

In an address by James E. Webb, the economic problems of the Midwest and the possibility of solving them through the joint effort of the universities and industries are discussed. Although midwestern universities lead in producing science doctorates, the midwestern states have the lowest ratio of scientists to total population of any region in the country. These facts are considered as symptoms of a lack of industrial enterprise and willingness to invest in the ability of mens' minds. Most midwestern companies either have not sought or have not been successful in obtaining research and development contracts from Government agencies. The fallacy of claiming geographical distance from large Government laboratories as the reason for this lack of contracts is exposed. Where a proven competence exists, it is NASA policy to support it. Therefore, industrial leaders should look to closer relations with the academic institutions of their region for their most important resources—ideas, scientific brainpower, creative talent, and advanced technological skill and experience. M.P.G.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-27977 Joint Publications Research Service, Washington, D.C.
OPTIMUM AERODYNAMIC MANEUVER FOR CHANGE OF ORBITAL PLANE DURING NEAR CIRCULAR SPEEDS
I. O. Mel'ts *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 1–11 ref (See N64-27976 20-23) OTS: $5.00

The variational problem about the optimum from the point of view of losses in maneuver speed is considered for small angles of trajectory slope to the local horizon and during speeds of flight close to circular. Under these conditions of equal (in terms of absolute values) angles of entry in the atmosphere and exit from it the optimum conditions of flight for a change of orbital plane are an almost constant angle-of-bank and an almost constant angle-of-attack, corresponding to maximum lift–drag ratio. For typical relationships of aerodynamic properties to attack angles finite expressions are obtained for optimum programs in terms of attack angle and bank in the general case. Author

N64-27978 Joint Publications Research Service, Washington, D.C.
A THEORY OF TRANSSONIC GAS FLOWS
I. M. Yur'yev *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 12–23 refs (See N64-27976 20-23) OTS: $5.00

With the help of new independent variables for Chaplygin's equations, very simple particular solutions are found for realizing flows in nozzles with a curvilinear line of transition for a good approximation of the Chaplygin coefficient in large transonic intervals of speed change. Also, conditions are fulfilled that guarantee a shockless nozzle with sufficiently steep walls for the supersonic part of the flow. Simple solutions for the Trikom equation can be obtained with an arbitrary number of constants that practically signify the solution of the problem of a nozzle in the general formulation. For exact solutions of the equations, the problem is reduced to the proof of the convergence of a power series, all coefficients of which depend on one arbitrary function characterizing the velocity distribution on the axis of symmetry of the nozzle. I.v.L.

N64-28070 Aeronautical Research Council (Gt. Brit.)
THE CALIBRATION OF A 60° CONE TO MEASURE MACH NUMBER, TOTAL PRESSURE AND FLOW ANGLES AT SUPERSONIC SPEEDS
D. R. Andrews and W. G. Sawyer London, HMSO, 1963 30 p refs
(ARC-CP-628; previously issued as RAE-TN-AERO-2825; ARC-24106) HMSO: 4s 6d

The characteristics of a 60° apex angle cone for measuring local Mach number, total pressure, and flow directions have been determined at Mach 2.47, 3.25, 3.97, and 4.32 at angles-of-pitch up to 29°. Author

N64-28173 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AXIALLY SYMMETRIC OSCILLATIONS OF CYLINDRICAL SHELLS IN SUPERSONIC FLOW OF GAS

K. K. Livanov *In its* Eng. Mag. 13 Feb. 1964 refs p 7–21 (See N64-28171 20-23)

In an investigation in a linear posing of problem on oscillations of cylindrical shells of finite length in a vacuum and in flow of gas simplified approaches are usually used, consisting of the fact that in equations of motion forces of inertia of longitudinal displacements are discarded, and the obtained simple equations of motion are solved by accurate methods or the Galerkin method; sometimes equations of motion are adopted by considering forces of inertia of all displacements, and are solved by the Galerkin method. A method is given of investigating axially symmetric oscillations of cylindrical shell, making it possible to obtain an accurate solution of the problem with a consideration of forces of inertia of all displacements. The method is discussed in reference to general equations of theory of shells that do not consider inertia of displacement. Author

N64-28301* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL INVESTIGATION OF ELECTRIC DRAG ON SATELLITES

Earl D. Knechtel and William C. Pitts Repr. from AIAA Journal, v. 2, no. 6, Jun. 1964 p 1148–1151 refs Presented at the AIAA Aerospace Sci. Meeting, N.Y., 20–22 Jan. 1964

(NASA-RP-280)

Accurate knowledge of the satellite drag coefficient is required for predicting satellite lifetime or for determining upper-atmospheric density from orbital decay rates. The purpose of this investigation was to determine the magnitude of the electric drag of conducting spheres and to establish which of the various assumptions used in the theories are plausible. These are some of the results: (1) The electric drag can be a significant part of the satellite ion drag; the magnitude of this drag is presented in graphic form. (2) A theory for electric drag must include both the impacting of ions on the surface and the shielding effect of the plasma sheath. (3) The drag produced by non-impacting ions is important for values of a/λ_D below about 10, but can be neglected for most practical satellite conditions. (The parameter a/λ_D relates a characteristic length of the satellite, namely its radius, to a characteristic length in the ambient plasma, or the Debye radius, which is typically much smaller than the satellite.) (4) A simple empirical relationship is derived that permits the rapid estimation of the electric drag of spheres over practical ranges of interest. I.v.L.

N64-28333* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL TECHNIQUE FOR MEASURING TOTAL AERODYNAMIC HEATING RATES TO BODIES OF ARBITRARY SHAPE WITH RESULTS FOR MACH 7

L. Roane and R. R. Howell Washington, NASA, Sep. 1964 36 p refs

(NASA-TN-D-2446) OTS: $1.00

A liquid-metal expansion technique for measuring the total heating rate to bodies of arbitrary shape is described. The calibration and test procedures required to afford useful data from the technique are delineated. In addition, the results obtained from three types of apparatus are presented to indicate the accuracy and reliability of the technique. Author

N64-28338* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF CONFIGURATION GEOMETRY ON THE TRANSONIC AERODYNAMIC CHARACTERISTICS OF CANARD AIRPLANE CONFIGURATIONS

James A. Blackwell, Jr. and Thomas C. Kelly Washington, NASA, Sept. 1964 74 p refs

(NASA-TN-D-2465) OTS: $2.00

An investigation was conducted in the 8-ft transonic pressure tunnel over a Mach number range of 0.40 to 1.20 to determine the effects of geometric variations on the aerodynamic characteristics of a canard airplane configuration. The geometric variations investigated were the effects of wing planform and vertical location, forebody deflection and length, and canard planform, deflection, and dihedral. The Reynolds number per foot of the tests varied with Mach number over a range of 1.69×10^6 to 3.11×10^6. Author

N64-28549 Aeronautical Research Associates of Princeton, Inc., N.J.

THE EFFECT OF SURFACE PERTURBATIONS ON THE PRESSURE DISTRIBUTIONS ABOUT BLUNT TWO-DIMENSIONAL BODIES AT HIGH MACH NUMBERS

Coleman duP. Donaldson, Roger D. Sullivan, and Wallace D. Hayes Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Apr. 1964 81 p refs

(Contract AF 33(657)-7313)

(FDL-TDR-64-17; AD-604036)

A method is presented to compute the change in pressure distribution that results when a basic shape, whose pressure distribution and flow field are known, is perturbed in some manner, either by deflection of a control surface or by an aeroelastic deformation. In order to illustrate the character of this perturbation problem, the linearized theory of the pressure distribution upon a perturbed flat plate, above which exists an entirely supersonic entropy layer, is developed in some detail and applied to the special case of the computation of flap effectiveness on blunt wedge airfoils at infinite Mach number. With the background of these results from the linearized theory, the more general problem is discussed, and an empirical method is suggested for computing the pressure distribution about a perturbed basic shape whose pressure distribution and flow field are known. The method is then used to compute the pressure distribution about a blunt two-dimensional airfoil for which both theoretical and experimental pressure distributions have been obtained at $M = 5$ and $M \simeq 8$. Author

N64-28605 ARO, Inc., Arnold Air Force Station, Tenn.

AERODYNAMIC DRAG ON SPIKED BLUNT BODIES IN LOW-DENSITY HYPERSONIC FLOW

William H. Sims and Jerry S. Hahn Arnold Eng. Develop. Center, Aug. 1964 28 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-64-160; AD-603567)

Aerodynamic drag on spiked blunt bodies was measured in hypersonic, low-density flow of nitrogen. Two models were tested: a spherically capped cone of 10° half-angle at $0 \leq \alpha \leq 40°$, and a right circular cylinder at $\alpha = 0$. Reynolds numbers, based on total body lengths and free-stream conditions, varied from 200 to 1200. Mach number was constant at 10.1. Results are compared with modified Newtonian and free-molecule calculations. Effects of hypersonic rarefied flow are apparent, with drag coefficient increasing for large angles-of-attack for all spike lengths. A correlation procedure suggested in an earlier report for a large class of similar bodies at 0° angle-of-attack is shown to be effective in the case of spiked bodies too. Author

N64-28612 ARO, Inc., Arnold Air Force Station, Tenn.
SUMMARY REPORT ON AERODYNAMIC CHARACTERISTICS OF STANDARD MODELS HB-1 AND HB-2
J. Don Gray Arnold Eng. Develop. Center, Jul. 1964 56 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-137; AD-602769)

All available test data on the standard hypersonic ballistic correlation models, HB-1 and HB-2, were examined to establish reference characteristics for use in the correlation of experimental results among the various aerodynamic facilities. The data presented are comprised primarily of static stability and zero-lift forebody axial-force coefficient results at Mach numbers from about 1.5 to 20 for a Reynolds number range from 0.01 to 2.7 × 10^6 based on centerbody diameter. Selected pressure distribution, dynamic stability, and heat-transfer data are included. Comparisons of data from various rest facilities show excellent correlation in spite of the appreciable Reynolds number of dependence of test results for model HB-2 with natural boundary-layer transition. Author

N64-28722* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MINIMUM DRAG BODIES WITH CROSS-SECTIONAL ELLIPTICITY
Jerold H. Suddath and Waldo I. Oehman Washington, NASA, Sep. 1964 28 p refs
(NASA-TN-D-2432) OTS: $0.75

Newtonian flow theory and the calculus of variations were used to study minimum drag shapes for bodies with cross-sectional ellipticity at hypersonic speeds and zero angle-of-attack. The study was made for conditions of given length and base height, given length and volume, given base height and volume, and given base height and surface area. Numerical examples for conditions of given length and base height and given length and volume are presented to assess the effect of cross-sectional ellipticity on body shape and pressure drag coefficient. The method of steepest descent was used for computations of body shapes with given length and volume. Author

N64-28732 Weapons Research Establishment (Australia) Dept. of Supply
THE FLIGHT DYNAMICS OF A BOMB WITH CRUCIFORM TAIL: NOTE ON THE EFFECT OF NON-LINEAR YAW-INDUCED ROLLING MOMENTS AND SIDE MOMENTS
W. R. Chadwick Sep. 1962 41 p refs
(WRE-TN-SAD-102)

A mathematical model was designed to describe the free-flight performance of a rigid ballistic missile. In conjunction with the IBM 7090 digital computer the model was used to determine the influence of nonlinear, yaw-induced rolling moments and side moments on the dynamic stability and performance of a typical bomb with cruciform tail. Specifically two problem areas relating to roll lock-in and catastrophic yaw were studied; the first associated with roll-yaw resonance and the second embracing flight instabilities that were observed to follow from large amplitude launching disturbances. As a result of these studies it was possible to establish criteria that should assist in improving bomb ballistic performance. Author

N64-28771 Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL TESTS AT M=2.0 ON INTERFERENCE EFFECTS BETWEEN INTAKE FLOWS IN A FOUR-ENGINE NACELLE
M. D. Dobson London HMSO 1964 47 p refs
(ARC-CP-753; Replaces RAE-TN-AERO-2920, ARC-25597)
HMSO: 10s

When the throttle of one cell was closed to give subcritical inlet flow, the shock geometry at the inlet was affected and pressure recovery and mass flow in the remaining cells were reduced. These reductions became progressively smaller in cells situated further from the throttle cell. Both pressure recovery and mass flow in a cell adjacent to one that was passing reduced flow were affected also by the presence of duct dividers in the intake. When the throttle of one cell was opened to give supercritical inlet flow, an adjacent cell was not affected if the duct was divided between the cells from the beginning of the subsonic diffuser. If the cells shared a common diffuser, the adjacent cell suffered reductions in both pressure recovery and mass flow. Author

N64-28834* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CONICAL AFTERBODY EFFECT ON THE REARWARD STATIC STABILITY OF A BLUNT-NOSED ENTRY VEHICLE AT MACH 4.54
13 Feb. 1964 46 p refs
(Contract NAS7-100)
(NASA-CR-58614; JPL-WT-20-565) OTS: $4.60 ph

Wind-tunnel Test 20-565 was a test of a typical entry vehicle with a conical body mounted upstream from the base of the vehicle by means of a cylindrical element. The purpose of the test was to investigate the effects on static stability of interference at a high supersonic velocity when a conical body is mounted upstream from the base of an entry vehicle. The model configuration comprised a conical afterbody, attached to a spherical-segment forebody by means of a cylindrical element, which has a diameter one-fourth the diameter of the forebody. For this test, however, the model attitude was reversed 180°, so that the denoted forebody and afterbody are acting as the afterbody and forebody, respectively. Forces and moments, measured by means of a strain-gage balance, were obtained for the complete configuration, which was tested in a rearward-entry attitude. Author

N64-28875 Naval Ordnance Lab., White Oak, Md.
AERODYNAMIC AND AEROTHERMODYNAMIC STUDIES ON THE HASP 1.0-INCH DIAMETER DART Aerodynamic Research Report No. 208
H. J. Gauzza 30 Apr. 1964 91 p refs
(NOLTR-63-210; AD-444337)

The High Altitude Sounding Projectile, HASP, was the subject of a design study aimed at enhancing the round's performance. The techniques used and the results obtained from this study are described. By decreasing the dart's diameter to 1.0 in. and using the standard MK 32 MOD 0 HASP motor, altitudes of 300,000 ft could be achieved. However, this improved performance is not attainable simply by scaling down the present 1.375-in.-diam dart. The following significant changes are required: an increased static margin, a decreased fin-cant angle, use of a fin material whose strength does not materially deteriorate at elevated temperatures, and thermal protection for the motor casing. Author

N64-28911 David Taylor Model Basin, Washington, D.C. Aerodynamics Lab.
WIND-TUNNEL INVESTIGATION OF FAVORABLE INTERFERENCE TO INCREASE LIFT-DRAG RATIOS OF SUPERSONIC AIRCRAFT. PART II: AN OPTIMIZED WING-BODY-INLET CONFIGURATION
Richard M. Hartley, Norman G. Ziegler, and David W. Moxley, Jr. Jun. 1964 40 p refs
(DTMB-AERO-1063, Pt. II; AD-604731)

The results of wind-tunnel tests conducted at Mach 2.87 to investigate favorable interference effects on wing-body-inlet configurations are presented. The engine air inlet location and the body indentation angle for maximum lift increments were determined. These favorable lift increments correspond to about 20% of the cruise lift required for an attack aircraft. A fence, attached to the wing to reflect the shock wave emanating from the engine air inlet and to intensify the pressure field, increased the inboard lift but not sufficiently to overcome the resulting loss in lift from the outboard section of the wing. Author

N64-28987 Illinois U., Urbana
A STUDY OF FLOW SEPARATION IN OVEREXPANDED, CONICAL, CONVERGENT-DIVERGENT NOZZLES (WITH SPECIAL CONSIDERATION OF THE EFFECT OF WALL DIVERGENCE ON MASS ENTRAINMENT)
Jamie Parker Lamb, Jr. (Ph.D. Thesis) Ann Arbor, Mich., University Microfilms, Inc., 1963 102 p refs

A theoretical flow model is developed for the separation-entrainment process in overexpanded models. The nature of the flow model is determined by the character of the boundary layer prior to separation. The fact that the boundary layer is usually turbulent rules out a rigorous, mathematical analysis and necessitates the use of physical models for the major components—separation and entrainment. Although the present study is largely analytical, considerable supporting evidence, obtained in the concurrent experimental program, is presented along with data from other researchers. The appendixes deal with the calculation of boundary-layer development in nozzles and with the thrust coefficient for overexpanded nozzles. I.v.L.

N64-28993* Mantle (Peter J.), Pasadena, Calif.
SPINNING SYMMETRIC MISSILES IN A NON-LINEAR AERODYNAMIC FIELD
Peter J. Mantle Mar. 1964 70 p refs
(Contract NAS2-661)
(NASA-CR-58582) OTS: $6.60 ph

The case of a spinning symmetric body flying at a constant speed where the aerodynamic restoring moment is an arbitrary function of the angle-of-attack is examined. The general problem is discussed, in suitable nondimensional form, to establish the generalized stability boundaries. Attention is directed to the inverse problem whereby the pertinent aerodynamic parameters are extracted from a given bounded solution, suitable for use in data reduction. The general case of nonplanar motion is examined and shown to be analogous to the classical orbital problems, differing only in the form of the governing potential function. The general solution is obtained in integral form, and the special cases of linear aerodynamics and cubic restoring moments have been integrated and studied to reveal all the pertinent characteristics. Author

N64-29009* National Aeronautics and Space Administration, Washington, D.C.
UNSTEADY FLOW PAST, AND FLEXURAL FLUTTER OF, BODIES OF REVOLUTION IN A SUPERSONIC STREAM [NEUSTANOVIVSHEYESYA OBTEKANIYE I IZGIBNYY FLATTER TEL VRASHCHENIYA V SVERKHZVUKOVOM POTOKE]
P. I. Zheludev Jul. 1964 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 1, 1964 p 158–162
(NASA-TT-F-9024) OTS: $1.10 ph

In formulating the theory of a slender body, consideration is given to the supersonic flow past bodies of revolution subject to elastic harmonic vibrations. Expressions are found for the velocity potential, the coefficient of pressure, and the transverse force distributed along the length of the body. Further consideration is given to elastic flexural vibrations of such bodies of revolution as a beam with one fixed end, the aerodynamic force being given from a previously determined expression for the transverse force of unsteady flow. The differential equation of the vibration is solved by the Bubnov–Galerkin method. An expression is found for calculating the frequency of natural vibrations, and examples of the calculation of the flutter velocity for a thin-walled conical beam are cited. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-27979 Joint Publications Research Service, Washington, D.C.
OSCILLATIONS OF CROSS-SHAPED WINGS OF FINITE SPAN IN A COMPRESSIBLE FLOW
B. I. Firdlender *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 24–38 refs (See N64-27976 20-23) OTS: $5.00

Determined is the potential of the speed of the perturbed portion of a compressible medium, which flows with velocity $M > 1$ past crosslike and T-form wings of finite span. The problem is solved linearly with the method of Hadamar with integral equations by the method of E. A. Krasil'shchikova. Author

N64-28025* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF ROLL CONTROLS APPLICABLE TO FIN-STABILIZED VEHICLES
Eugene D. Schult Washington, NASA, Aug. 1964 22 p refs (NASA-TR-R-197) OTS: $0.50

This paper discusses the rolling effectiveness of deflected fins, flaps, spoilers, and jet devices that may be employed on fin-stabilized vehicles. The possible applications and some of the significant factors affecting the performance of each device are described. The experimental information has been published previously and was obtained chiefly from free-flight tests of fin-stabilized vehicles at Mach numbers up to approximately 2.0. Comparisons are made in some cases with existing theory, which is also relied upon to indicate trends where data are not available. Author

N64-28032 Aeronautical Research Council (Gt. Brit.)
COMPARATIVE THRUST MEASUREMENTS ON A SERIES OF JET-FLAP CONFIGURATIONS AND CIRCULAR NOZZLES
M. N. Wood London, HMSO, 1962 18 p refs
(ARC-CP-616; previously issued as RAE-TN-AERO-2804; ARC-23695) HMSO: 2s 9d

Thrust measurements were made with a range of jet-flap blowing configurations in an attempt to clarify the origins of the momentum losses associated with jet-flap wings. As a basis for comparison, thrust measurements were also made on a series of simple circular nozzles. The relative importance of various factors that contribute to the losses was determined, and ways of reducing the losses are suggested. Author

N64-28083 Aeronautical Research Council (Gt. Brit.)
THE CHARACTERISTICS OF SOME SLENDER CAMBERED GOTHIC WINGS AT MACH NUMBERS FROM 0.4 TO 2.0
L. C. Squire London, HMSO, 1964 48 p refs
(ARC-RM-3370; Previously issued RAE-AERO-2663, ARC-24258) HMSO: 18s 6d

Wind-tunnel tests were made on a series of cambered slender wings of modified gothic planform. The main purpose of these tests was to investigate camber designs that have low lift-dependent drag and a given center-of-pressure position ahead of the aerodynamic center. The results show that at the design conditions the center-of-pressure position is close to, or slightly ahead of, the design position, and the trimming power associated with the forward position of center of pressure is largely maintained throughout the speed range. The maximum lift–drag ratios of the cambered wings are slightly greater than those of the uncambered wing. Author

N64-28324* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT TRANSFER AND PRESSURE MEASUREMENTS ON DELTA WINGS AT MACH NUMBERS OF 3.51 AND 4.65 AND ANGLES OF ATTACK FROM −45° TO 45°
Robert L. Stallings, Jr., Paige B. Burbank, and Dorothy T Howell Washington, NASA, Aug. 1964 178 p refs
(NASA-TN-D-2387) OTS: $3.00

Throughout the angle-of-attack range for which the stagnation line remained on the wing cylindrical leading edge, the pressure distributions on the leading edges of the models through 60° expansion leeward of the stagnation line were predicted by both Newtonian flow and a modified version of the compressible Bernoulli equation based on normal Mach number components. For expansion angles from 60° to 90°, the experimental data were in agreement with the compressible Bernoulli equation. For angles-of-attack for which the stagnation line shifts from the geometrical wing leading edges to the ridge line, the pressure distributions on the wing leading edges (now trailing edges) were approximated only by the Newtonian flow. The windward-panel center-line pressures for both sharp-nose models were correlated throughout the Mach number and angle-of-attack ranges of this investigation by the parameter M sin α, where M is the free-stream Mach number and α is the angle-of-attack. The pressures obtained off the center line on the windward panel of the body with 24.3° dihedral were correlated by the same parameter based on the effective angle-of-attack of the wing panel. Author

N64-28325* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DATA ON LARGE SEMISPAN TILTING WING WITH 0.6-DIAMETER CHORD, SINGLE-SLOTTED FLAP, AND SINGLE PROPELLER ROTATING DOWN AT TIP
Marvin P. Fink, Robert G. Mitchell, and Lucy C. White Washington, NASA, Aug. 1964 146 p refs
(NASA-TN-D-2412) OTS: $2.75

An investigation was made in a full-scale tunnel to determine the longitudinal aerodynamic characteristics of a large-scale semispan V/STOL tilt-wing configuration having a single propeller with propeller rotation such that the blades rotated downward at the wing tip and upward near the root. The wing had a chord to propeller-diameter ratio of 0.6, a single-slotted flap, and aspect ratio of 4.05 (2.025 for the semispan), a taper ratio of 1.0, and an NACA 4415 airfoil section. The data were not analyzed in detail, but were examined to observe general trends. The portion of the wing outboard of the nacelle practically never stalls, evidently because of the wing-tip effect and because of the reduction in angle-of-attack over that portion of the wing caused by the slipstream rotation that is downward at the wing tip. The stall starts at the trailing edge of the wing root and progresses smoothly forward and outboard. The use of the leading-edge slat is beneficial in that it extends the lift curves to higher angles-of-attack and higher maximum lift coefficients with the flap down at moderate values of thrust coefficient, and it was also benficial with flap up at low values of thrust coefficient. Author

N64-28337* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL MEASUREMENTS ON A LIFTING ROTOR AT HIGH THRUST COEFFICIENTS AND HIGH TIP-SPEED RATIOS
George E. Sweet, Julian L. Jenkins, Jr., and Matthew M. Winston Washington, NASA, Sep. 1964, 56 p refs
(NASA-TN-D-2462) OTS: $1.50

Results are presented from an investigation of the performance and static stability characteristics of a 15-ft-diam rotor operating at conditions expected to produce large amounts of blade stall. Rotor forces, power, and flapping motions were recorded for rotor tip-path-plane angles-of-attack of 10.5°, 0.5°, and −9.5° at tip-speed ratios from 0.25 to 0.56. Portions of the data are compared with theoretical calculations. At theoretically unstalled operating conditions, the agreement between measured and calculated rotor thrust was good. However, when rotor-blade stall was theoretically predicted, thrust measurements did not indicate the large blade lift losses predicted by theory. The measured profile power was significantly greater than calculated for conditions in which no stall was expected. The longitudinal rotor flapping did not show any sudden divergence when stall was encountered. The rotor exhibited stabilizing trends for large changes in angle-of-attack. Author

N64-28486 Joint Publications Research Service, Washington, D.C.
THEOREM OF REVERSIBILITY WITH STABILIZED MOTION OF ANNULAR WING AND BODY
A. F. Moiseyenko *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 271–286 refs (See N64-28469 20-01) OTS: $7.00

The theorem of reversibility for stabilized motion of an annular wing and coaxial infinite cylinder is proved, based on earlier work that established a relationship between the aerodynamic characteristics of straight and reversed monoplane wings of any shape in one plane. The deductions presented are true within the limits of linear theory at any speed in a stabilized flow, provided that: (1) motion is taking place at a finite value of forward velocity and relatively small values of the other parameters of motion; (2) the bearing surface is slightly curved and is moving in an unrestricted space; (3) the medium at infinity ahead of the body is still and does not have any sources of disturbances other than the body and its wake. M.P.G.

N64-28770 Aeronautical Research Council (Gt. Brit.)
USE OF A WIND TUNNEL TO DETERMINE THE PERFORMANCE OF SLENDER WINGS SUITABLE FOR A SUPERSONIC TRANSPORT AIRCRAFT
J. Y. G. Evans London, HMSO, 1964 23 p refs
(ARC-CP-742 replaces RAE-TN-AERO-2884, ARC-24818) HMSO: 4s 6d

Drag coefficients obtained from surface pressure measurements are compared with those derived from balance measurements, both with free and with artificially fixed boundary-layer transition, to judge whether such wind-tunnel tests can be used to predict the performance of the types being studied for supersonic transport aircraft. While a satisfactory level of accuracy can be achieved in most cases at zero lift, a better understanding of the boundary-layer behavior over such wings at incidence is required before results on a lifting model can be extrapolated to full scale with full confidence. Author

N64-28986 Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF OPTIMUM INCIDENCES FOR AEROFOILS
A. D. S. Carter London, HMSO, 1963 19 p refs
(ARC-CP-646; replaces ARC-22855) HMSO: 3s 6d

Existing methods for calculating the optimum incidence of aerofoils in cascade are so empirical that they could not be extended to new profiles without more supporting test work. A more fundamental approach involving less empiricism was therefore sought. By associating the optimum incidence with a fixed position of the front stagnation point on the leading edge, a method is suggested enabling this incidence to be calculated from a knowledge of the reversed flow. The method was applied to a wide range of compressor cascades and gave satisfactory results, except perhaps at very low cambers. The method applies essentially to profiles formed by using the C50 camber line for which extensive test information and experience is available. It also agrees with all the more limited test data available on the P40 camber line. It is therefore assumed that it would apply to other profiles likely to be used in axial flow compressors. Since the method involves only one empirical constant, it may be used with much greater confidence for cascades outside the range of present experience. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-28103 Aeronautical Research Council (Gt. Brit.)
AN EXTENSIVE THEORETICAL STUDY OF THE ABILITY OF SLENDER-WING AIRCRAFT TO PERFORM SIDESTEP MANOEUVRES AT APPROACH SPEEDS
B. N. Tomlinson London, HMSO, 1964 31 p refs
(ARC-RM-3359; previously issued as RAE-TM-AERO-2837, ARC-24467) HMSO: 12s

The sidestep maneuver is investigated in some detail for a slender-wing aircraft by specifying the bank-angle time history and by determining the required control angles. The effect of inclusion of the full inertia terms, the influence of different bank-angle time histories, and the consequences of wide variations in the aerodynamic derivatives are examined. It is not necessary to include the full inertia terms in the equation of motion. An efficient maneuver requires a rapid initial growth of roll angle; if this is not achieved, subsequent control demands are large, and only a small sidestep distance is achieved. Besides control effectiveness, the most important derivatives are the yawing moment due to aileron, the rolling moment due to rudder, and the yawing moment due to rate of roll. Rudder requirements are much greater than aileron requirements. Author

N64-28168 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LATERAL VIBRATIONS OF AN AIRCRAFT, CAUSED BY EFFECT OF WIND GUSTS
A. S. Dubov 27 Dec. 1963 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ., Vopr. Aviats. Meteorol., (Leningrad), No. 98, 1959 p 3–16
(FTD-MT-63-118; AD-602598)

Equations are derived establishing the connection between lateral vibrations of aircraft and horizontal gusts. These equations are written in general form, taking into account possible differences of the wind components acting on different sections of the boundary layer of the aircraft. The solution is introduced for the particular case when the wind can be assigned one value, by averaging all along the boundary layer of the aircraft. An analysis is conducted of the effect of gusts of different intensities on the side acceleration of the aircraft's center of gravity. The possibility of finding the inverse problem—the characteristics of the horizontal gustiness of the wind by side accelerations of the aircraft—is explained. Numerical calculations were made for the Northrop 2E aircraft. I.v.L

N64-28229* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
STATUS OF V/STOL RESEARCH AND DEVELOPMENT IN THE UNITED STATES
John P. Campbell Repr. from J. of Aircraft, May–Jun. 1964 p 97–106 refs Presented at the AIAA/CASI/RAeS 9th Anglo-Am. Conf., Cambridge, Mass., 16–18 Oct.; Montreal, Canada, 21–24 Oct. 1963
(NASA-RP-286)

The present state-of-the-art of V/STOL aircraft is discussed. Information is presented on the helicopter, propeller, ducted-fan, and turbojet aircraft, and on V/STOL handling qualities. A research interest is indicated in helicopters because of various recent developments, such as the hingeless-rotor helicopter. Among the types of aircraft discussed are propeller and ducted-fan V/STOL types. IAA

N64-28323* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AERODYNAMIC CHARACTERISTICS OF A FULL-SCALE FAN-IN-WING MODEL INCLUDING RESULTS IN GROUND EFFECT WITH NOSE-FAN PITCH CONTROL
Jerry V. Kirk, David H. Hickey, and Leo P. Hall Washington, NASA, Jul. 1964 147 p refs
(NASA-TN-D-2368) OTS: $2.75

An investigation was conducted to determine the low-speed aerodynamic characteristics (in and out of ground effect) of a full-scale fan-in-wing VTOL model incorporating a fan in the nose of the fuselage for trim and pitching-moment control. The model had a midmounted wing of aspect ratio 3:1. Results were obtained with the wing at 3.85, 2.2, 1.7, and 1.0 fan diameters above the tunnel floor. The high position was considered out of ground effect. The effects on longitudinal characteristics of lift-fan performance were obtained at all positions tested while longitudinal characteristics with the pitch fan operating were obtained for only the three positions considered

in ground effect. Longitudinal and lateral-directional characteristics were studied in the high position with the lift fans operating and with various settings of the fan exit vanes to control fan thrust and produce yaw and roll. Various trailing-edge flap deflections were tested with the model in the high position, and the optimum setting of 45° was then used throughout the remainder of the program. Author

N64-28328* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PILOT EVALUATION OF DYNAMIC STABILITY CHARACTERISTICS OF A SUPERSONIC TRANSPORT IN CRUISING FLIGHT USING A FIXED-BASED SIMULATOR
Milton D. Mc Laughlin and James B. Whitten Washington, NASA, Sep. 1964 21 p refs
(NASA-TN-D-2436) OTS: $0.50

An investigation was made of the pilot's ability to control a simulated supersonic transport at a Mach 3 and an altitude of 70,000 ft, with emphasis on regions of low stability and damping characteristics. The fixed-base simulator employed no outside visual or motion cues and no outside disturbances. Routine tasks such as maintaining constant altitude, changing altitude, and changing heading were performed. Desirable stick forces and sensitivities were also determined. The investigation was divided into studies of the longitudinal stability characteristics and of the lateral-directional characteristics. In investigating one mode the stability and damping of the other mode were increased to a satisfactory level. Pilot's ratings of the longitudinal stability and control characteristics were generally acceptable (pilot rating of 4) for configurations having short-period frequencies of 0.13 to 0.37 cps, damping ratios of 0.06 to 0.36, and compatible control characteristics. Pilots preferred longitudinal stick sensitivities of 0.1 to 0.2 g/in. stick deflection and stick-force gradients of approximately 20 to 40 lb/g normal acceleration. Author

N64-28797 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
APPLICATION OF A RATIONAL-PROBABILITY ANALYSIS FOR DETERMINATION OF ULTIMATE DESIGN LOADS ON LARGE, FLEXIBLE, MILITARY AIRCRAFT Technical Documentary Report, Oct. 1963–Mar. 1964
William H. Austin, Jr. May 1964 10 p refs
(SEG-TDR-64-24; AD-601777)

Recent experiences with B-52 aircraft have indicated that the current structural design criteria are inadequate for large, flexible, military aircraft. A rational-probability analytical procedure was established to overcome this problem. This analysis determines ultimate loads for which the vehicle must be designed in order to achieve the specified acceptable failure rate due to structural overload. The basis for the analysis is the acceptable failure rate, the dynamic spectral analysis, and the spectral exceedance curves. By use of this analysis, mission and performance trade-offs can be established in terms of probability of failure due to structural overload. With some modification, this type of analysis can be applied to all types of aircraft. Author

N64-28847 Aeronautical Research Council (Gt. Brit.)
ATMOSPHERIC TURBULENCE ENCOUNTERED BY COMET 2 AIRCRAFT CARRYING CLOUD COLLISION WARNING RADAR
Judy E. Aplin London, HMSO, 1964 39 p refs
(ARC-CP-713; replaces RAE-TN-STRUCT-335, ARC-25141) HMSO: 8s 6d

Counting accelerometer records were obtained for the turbulence encountered by R.A.F. Comet 2 aircraft, equipped with cloud collision warning radar, in 335,000 miles of operational flying largely on routes connecting the U.K. with Singapore. The Comet 2 met significantly less turbulence at all altitudes than the Comet 1, which was not carrying this radar, and the reduction in the frequency of occurrence of gusts increased with gust magnitude. No gusts as great as 20 ft/sec were recorded by Comet 2 aircraft during the cruise. Comparable data from U.S. aircraft were also considered, and show a similar reduction in the occurrence of large gusts. Author

N64-28851 Aeronautical Research Council (Gt. Brit.)
ANNUAL VARIATION OF FLIGHT LOADS RECORDED ON VISCOUNT AIRCRAFT BY MEANS OF THE FATIGUE LOAD METER
R. Hain Taylor London, HMSO, 1964 25 p refs
(ARC-CP-667; supersedes RAE-TN-STRUCT-322, ARC-24847) HMSO: 7s 6d

Flight load data collected by means of fatigue load meters from Viscount aircraft are presented in full. An analysis is made to determine whether there is any regular annual variation of these flight loads (and consequently, it is believed, of the atmospheric turbulence that causes them). Such an annual variation is shown to exist, and to differ for the two geographical areas concerned (Britain and Australia). Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see:* 12 Geophysics, and 29 Space Sciences.

N64-27925* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASUREMENT OF ERRORS IN MANUALLY RECORDING TRANSIT TIMES OF STARS AND DISTANT PLANETS
Kenneth R. Garren and Patrick A. Gainer Washington, NASA, Aug. 1964 17 p refs
(NASA-TN-D-2433) OTS: $0.50

An experimental investigation has been conducted to determine the accuracy with which celestial body transit times can be manually recorded. This investigation determined the effects on the timing-error variance of both celestial-body size and the apparent rate of motion of the celestial body through the observer's field of view. The celestial bodies simulated were Jupiter (as seen through a 12-power telescope of 2-in. aperture) and a first-magnitude star (as seen through a 60-power telescope of 2-in. aperture). The apparent rates of motion simulated varied between 56° and 224° per minute. Also an observer's ability to measure the time interval between successive body transits was determined. Results of the investigation showed that the standard deviation in the timing error varied approximately inversely as the apparent rate of motion. Standard deviations were slightly less for the star than for the planet. Also the error variance in recording a time interval between body transits was approximately equal to the error variance in recording a single-body transit. From the data an empirical graph was derived that shows expected error in measuring the angle between two celestial bodies plotted against actual rate of rotation for various values of instrument magnification. Author

N64-28023* National Aeronautics and Space Administration, Washington, D.C.
PHOTOMETRIC PROPERTIES OF LUNAR CRATER FLOORS
J. van Diggelen Aug. 1964 162 p refs .Transl. into ENGLISH from Rech. Astr. Obs. Utrecht (Netherlands), v. XIV, no. 2, 1958
(NASA-TT-F-209) OTS: $3.00

This paper discusses observations of the radiance of crater floors, comparison between the observed radiances, measurement results, theoretical and empirical phase functions, the theoretical photometric function of a rough surface with shadow formations, an experimental investigation of the radiance of volcanic ashes, photometric properties of glass beads, an experimental investigation of models, and the structure and composition of the lunar surface. G.D.B.

N64-28089 Manchester U., Macclesfield (Gt. Brit.) Nuffield Radio Astronomy Labs.
THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO STARS BY THE LUNAR OCCULTATION TECHNIQUE. OBSERVATIONS OF GALACTIC AND EXTRAGALACTIC EMISSION AT 408 Mc/s Progress Report, Oct.–Dec. 1963
Conrad H. Slater, C. G. T. Haslam, and M. J. S. Quigley [1963] 11 p refs
(Contract N62558-3928)
(PR-1; AD-439350)

Observations of the 1963 occultations of 3C273, 3C17, and 3C245 are reported. The index of zodiacal sources and the zodiacal survey are discussed. A search for unpredicted occulations was made. Observations of galactic and of extragalactic emissions at 408 mc/s are described. G.D.B.

N64-28121* Smithsonian Astrophysical Observatory, Cambridge, Mass.
TESSERAL HARMONICS OF THE GEOPOTENTIAL AND CORRECTIONS TO STATION COORDINATES
Imre G. Izsak Repr. from J. Geophys. Res., v. 69, no. 12, 15 Jun. 1964 p 2621–2630 refs
(Grant NsG-87-60)

A total of 15,191 precisely reduced Baker–Nunn camera observations of 10 artificial satellites were analyzed to obtain new least-squares estimates for the coefficients of tesseral and sectorial harmonics of the geopotential and for the individual corrections to the coordinates of the Smithsonian Astrophysical Observatory's 12 tracking stations. An IBM 7094 computer program as used in this analysis is described in some detail, and several solutions of varying complexity are offered. The method yields estimates of geophysical significance for harmonics up to the sixth degree. The results concerning the camera sites agree reasonably well with those arrived at by the geometrical method of simultaneous observations in cases when the latter are available. Author

N64-28340* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DISCUSSION OF HALPHEN'S METHOD FOR SECULAR PERTURBATIONS AND ITS APPLICATION TO THE DETERMINATION OF LONG RANGE EFFECTS IN THE MOTIONS OF CELESTIAL BODIES. Part 2
Arthur J. Smith, Jr. Washington, NASA, Jun. 1964 77 p refs (NASA-TR-R-194) OTS: $2.00

This paper discusses some applications of Halphen's method for determining the long-range (secular) perturbations for planetary- and cometary-type orbits. This method of treating secular planetary effects was suggested by Musen for the determination of the long-range perturbations due to the moon for artificial satellite orbits. Two FORTRAN II computer programs incorporating this method are described, and representative results are presented. The comparison of results obtained here with those obtained by applying other methods demonstrates the adequacy of this method for minor planets and appropriate artificial satellites. Considerable saving in computer time can be made in the study of artificial satellite orbits when the short period perturbations are not of interest by using a program based on Halphen's method rather than one based on the use of an unaveraged disturbing function. The program for artificial satellites is given. Author

N64-28384 Joint Publications Research Service, Washington, D.C.
STUDY OF THE MASS-LUMINOSITY-RADIUS CORRELATION
A. S. Sharov *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 374–376 (See N64-28376 20-29) OTS: $6.00

This paper deals with data on visual binary and eclipsing binary stars. Mean values of giant star mass, obtained by the Beer method, and mean values of giant star mass obtained by the Berglund method, were used. For the mass values of stars in close proximity on the spectrum-luminosity diagram, the mean weighted values were used. G.D.B.

N64-28385 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE SPATIAL VELOCITIES OF THE STARS
T. S. Kirillova *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 377–380 (See N64-28376 20-29) OTS: $6.00

This article discusses those stars that could provide accurate spatial velocities. Stars with approximating characteristics are combined into groups. The division into groups was made on the basis of the position on the spectrum—absolute magnitude diagram. For each group, the kinematic elements were determined—apex of sun movement in relation to the given group of stars (three elements), and the constants characterizing the ellipsoidal distribution of velocities. G.D.B.

N64-28386 Joint Publications Research Service, Washington, D.C.
THE GRAVITATIONAL POTENTIAL OF THE GALAXY
A. S. Sharov *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 381–382 (See N64-28376 20-29) OTS: $6.00

Derived is an analytical expression of ϕ for the galactic plane, from the equation correlating ϕ with circular velocity V_{θ_c}, on the condition that the circular velocity is expressed in the same manner as the rotary velocity of centroids in the dynamics of the steady-state galaxy. G.D.B.

N64-28391 Joint Publications Research Service, Washington, D.C.
THE ORIGIN OF INTERSTELLAR POLARIZATION
S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 391–392 (See N64-28376 20-29) OTS: $6.00

Considered is the mechanism of ordering long-axes orientation of interstellar dust particles in a magnetic field, which is necessary for explaining distant starlight polarization. G.D.B.

N64-28392 Joint Publications Research Service, Washington, D.C.
STELLAR MAGNETIC FIELDS
S. B. Pikel'ner *In its* Probl. of Cosmogony Vol. III 6 Jul. 1964 p 393–394 (See N64-28376 20-29) OTS: $6.00

With an analyzer of circular polarization, observations were made of the magnetic field of more than 25 stars of classes A and F, exhibiting various specific features in their spectrum. Variable fields were found in almost all of the stars, whereas in four stars, the polarity undergoes a periodical change. G.D.B.

N64-28393 Joint Publications Research Service, Washington, D.C.
LUMINOUS INTERGALACTIC MATTER
Yu. I. Yefremov *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 395–396 (See N64-28376 20-29) OTS: $6.00

The existence of matter between galaxies must increase the average density of the observed portion of the universe, possibly up to 10^{-26} g/cm^3. The existence of separate intergalactic stars and groups of stars provides a new foundation for the contention that the luminosity function of galaxies increases with the decrease of absolute stellar magnitude. The presence of connecting links facilitates a differentiation of proximate groups and permits determination of masses of galaxies by using the dispersion of radial velocities. G.D.B.

N64-28413* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEW SPECTRA OF SYMBIOTIC STARS
Francois V. Dosson Repr. from Astron. J., v. 69, no. 2, Mar. 1964 1 p
(NASA-RP-268)

The spectroscopic observation of symbiotic stars has been extended in two ways: first, by increasing the resolution in the ordinary range of wavelength; and second, by extending the spectroscopic investigation to the photographic infrared. The best spectra have been obtained for Z Andromedae in the photographic region and for BF Cygni in the infrared. Analysis of Z Andromedae spectra reveals numerous new multiplets and individual lines, principally of Fe II and Cr II; the hydrogen emission lines indicate that the star was surrounded by a slowly expanding atmosphere; and the spectra of ionized oxygen and nitrogen give some evidence of a fluorescent excitation process. Analysis of the near-infrared spectra of BF Cygni and other symbiotic stars confirms the general similarities between the symbiotic stars. Series spectrograms show that the intensity ratios of several emission lines vary quite rapidly. M.P.G.

N64-28524* IIT Research Inst., Chicago, Ill. Astro Sciences Center
A COMPENDIUM OF DATA ON SOME PERIODIC COMETS
D. L. Roberts 20 Jul. 1964 113 p refs
(Contract NASr-65(06))
(NASA-CR-58544; P-9) OTS: $9.60 ph

This compendium of data presents ordered information on all periodic comets already observed twice and expected to pass perihelion within the next 25 years. In addition to the retrospective data, also included are predictions of the future dates of perihelion, within the time period considered and based on detailed perturbation calculations. The periodic comet of outstanding scientific interest is Halley's comet, due to return in 1986. A valuable experiment will be to send a probe through the coma and tail of Halley's comet and to pass as near the nucleus as possible. Due to its long orbital period and the potential scientific value of an intercept with Halley's comet, launching some comet probes before 1986 is advisable so that the experimental techniques can be evaluated and perfected; suitable comets are listed. Author

N64-28530 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
COLLISIONS OF THE WEST FORD NEEDLES WITH MICROMETEORITES
A. Sauval 28 Jul. 1964 12 p refs Transl. into ENGLISH from Bull. Soc. Roy. Sci. (Belgium), v. 32, no. 1–2, 1963 p 54–61 (RSIC-235; AD-604328)

Collisions of micrometeorites with West Ford Project needles are sufficiently numerous to break the needles in several years. These collisions may affect the lifetime of the orbit (predicted period of eight years) and of the experiment. Author

N64-28544 Hamburger Sternwarte (W. Germany)
STRUCTURE AND DEVELOPMENT OF COMETARY TAIL Final Report
K. Wurm 31 Mar. 1964 47 p refs
(Contract AF 61(052)-583)
(AFCRL-64-646; AD-604048)

CONTENTS:
1. THE IONIZATION IN COMETS p 4–12 refs
2. BRIGHTNESS AND STRUCTURE OF THE Na-EMISSION IN COMETS p 13–21 refs
3. THE HEADS OF COMETS AND THE LIFETIMES OF THEIR MOLECULES p 22–28 refs
4. THE AXES OF THE TYPE I-TAILS OF COMETS p 29-38 refs
5. AN EXPANDING HALO OF COMET ALCOCK (1963b) INDEX CARDS p 39–44

N64-28625 American Meteorological Society, Boston, Mass.
CONCERNING N. A. KOZYREV'S ARTICLE "EXPLANATION OF THE COLOR OF MARS BY THE SPECTRAL PROPERTIES OF ITS ATMOSPHERE" [PO POVODU STAT'I N. A. KOZYREVA "OB IASNENIE TSVETA MARSA SPEKTRAL'NYMI SVOISTVAMI EGO ATMOSFERY"]
G. A. Tikhov Bedford, Mass., AFCRL, Mar. 1964 7 p ref Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), no. 16, 1956 p 159–161
(Contract AF 19(628)-3880)
(T-R-423$^+$; AD-602202)

In this paper, the author substantiates his reasons for believing that Kozyrev's conclusion that the red color of Mars is determined solely by the properties of its atmosphere is incorrect. R.T.K.

N64-28654* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
GRAVITATIONAL COLLAPSE
Hong-Yee Chiu Repr. from Phys. Today, May 1964 p 21–34 refs
(NASA-RP-273)

This report reviews topics on "quasi-stellar radio sources" (quasars) as discussed at the International Symposium on Gravitational Collapse and Other Topics in Relativistic Astrophysics. Quasars are massive objects with a mass $\geq 10^8$ ·, confined to a space of about one parsec. They are not composed of stars, but seem to be coherent masses. Their lifetime is at least 10^5 years. They radiate radio waves strongly, but radiate most strongly in the optical region. Their surface

is composed of very tenuous matter of a particle-number density of the order of $10^7/cm^3$, and their total energy content is larger than the rest energy of 10^6 ·. All of the 10^{60} ergs of energy ($= 10^6 \cdot c^2$) are in the form of magnetic fields and high-energy particles, and a possible energy source is gravitational energy, which can be released in violent events (e.g., collapse). Thus, all of the energy released may be in the form of high-energy particles. The prevalent theory of gravitation is that general relativity predicts some singularities, and these singularities are discussed. I.v.L.

N64-28679 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADIO-ECHO STUDIES OF METEORS AT 68-CM WAVELENGTH. PART II: SHOWER METEORS
J. V. Evans and R. A. Brockelman 15 Jan. 1964 64 p refs
(Contract AF 19(628)-500)
(Tech. Rept.-341: ESD-TDR-64-17; AD-601518) OTS: $3.00

Radio-echo observations of five nighttime meteor showers are described. The observations were made at a wavelength of 68 cm and constitute part of a program of meteor observations carried out in the period 1960 to 1962 at the Millstone Hill Radar Observatory. The values for the velocities of the showers are presented and compared with values from other sources. The mean heights and trail lengths of these meteors are also given. Very precise velocity and deceleration measurements are presented for Quadrantid and Geminid meterors. These measurements were made by directing the radar beam along the path of the approaching meteors and determining the velocity directly from the doppler shift. These precise deceleration measurements are compared with the simple meteor theory for the case of free molecular flow. In a large number of cases the theory is inadequate and cap formation for these meteors begins at heights somewhat above 100 km. Author

N64-28683 Centro di Studio per la Fisica delle Microonde, Florence (Italy)
METEOR DATA BULLETIN NO. 15, MAY 1963
Anna Consortini et al Apr. 1964 20 p refs
(Partially Sponsored by USAF and Consiglio Nazl. delle Ric., Italy)

This bulletin presents some elaboration of the meteor radar data obtained at the Centro Microonde in May 1963. From the data, the hourly rate was analyzed as a function of the time, antenna direction, and radar distance. The distribution of the echo duration and the duty cycle were computed. More detailed observations of particular behaviors are reported. The principal characteristics of the radar are frequency–39.5 MHz, peak power–15 kw, pulse width—16μs, and pulse rate–150 p/s. The aerial beam width to half-power is azimuth–30°, and elevation–50°. The elevation of the antenna axis is ~ 60°. The geographical coordinates of the station are geographical latitude–43° 48′ N, geographical longitude–11° 48′ E, and altitude–55 m on the sea level. The time used is the mean time of Central Europe (GMT + 1 hr). The observations were performed during time intervals of 24 hr, from 9 a.m. of one day to 9 a.m. of the following day. The antenna was continuously rotating a velocity of 12°/min. Also, titles of reports on meteor research are listed. I.v.L.

N64-28684 Centro di Studio per la Fisica delle Microonde, Florence (Italy)
METEOR DATA BULLETIN NO. 16, NOVEMBER–DECEMBER 1963
Anna Consortini et al Apr. 1964 20 p refs
(Partially sponsored by USAF and Consiglio Nazl. Delle Ric., Italy)

This bulletin presents some elaborations of the meteor radar data obtained at the Centro Microonde in the period November–December 1963. From the data, the hourly rate was analyzed as a function of the time, antenna direction, and radar distance. The distribution of the echo duration and the duty cycle were computed. More detailed observations of particular behaviors are reported. Also, titles of reports on meteor research are listed. I.v.L.

N64-28685 Centro di Studio per la Fisica delle Microonde, Florence (Italy)
METEOR DATA BULLETIN NO. 17, FEBRUARY 1964
Ann Consortini et al Apr. 1964 17 p refs
(Partially sponsored by USAF and Consiglio Nazl. Delle Ric., Italy)

This bulletin presents some elaborations of the meteor radar data obtained at the Centro Microonde in February 1964. From these data, the hourly rate was analyzed as a function of time, antenna direction, and radar distance. The distribution of the echo duration and the duty cycle were computed. More detailed observations of particular behaviors are reported. Also, titles of reports concerning meteor research are listed. I.v.L.

N64-28686 Centro di Studio per la Fisica delle Microonde, Florence (Italy)
METEOR DATA BULLETIN NO. 18, MARCH 1964
Anna Consortini et al 1964 18 p refs
(Sponsored by Consiglio Nazl. delle Ric., Italy)

This bulletin presents some elaborations of the meteor radar data obtained at the Centro Microonde in March 1964. From the data, the hourly rate was analyzed as a function of the time, antenna direction, and radar distance. The distribution of the echo duration and the duty cycle were computed. Author

N64-28710 Arizona U., Tucson Lunar and Planetary Lab.
INVESTIGATION OF O AND B SPECTRA OF STARS Progress Report, Period Ending 1 Jun. 1964
B. M. Middlehurst [1964] 4 p refs
(Contract Nonr(G)-00029-64)
(AD-600878)

Forty-two plates of O and B stars, most of which are usable, were received. About half of these were of cluster stars. So far, about half of the cluster plates have been measured. Indications are that, in some stars, the red shift is shared between H and He lines, but that it is not so great in the lines of other elements. Possibilities for the cause of this shift include blending of the lines, the presence of a companion, the presence of measurable quantities of He, the infall of gas from the surrounding nebulosity, convection in the surface layers of a star with enhancement of H and He lines in the downward currents, and β Lyrae or U Ceph phenomena. I.v.L.

N64-28841* California U., Berkeley Space Sciences Lab.
A RE-EVALUATION OF W. H. W. WRIGHT'S PLATES OF THE 1924 AND 1926 OPPOSITION OF MARS
R. A. Wells 22 Jul. 1964 28 p refs *Its* Ser. 5, Issue 43
(Grant NsG-101-61)
(NASA-CR-58354) OTS: $2.60 ph

Micrometric and microphotometric measurements were made of Wright's plates. The data obtained were reduced by the IBM-7090 computer and then compared with Wright's results. It was found that the problems arising in the photographic determination of planetary diameters fall into two

categories—problems associated with the optical system and tracking, and problems concerning the photographic plates (the photographic emulsion). I.v.L.

N64-28868 American Meteorological Society, Boston, Mass.
RESULTS OF OBSERVATIONS OF MARS [REZUL'TATY NABLIUDENII MARSA]
Iu. N. Lipskii [1957] 8 p Transl. into ENGLISH from Priroda (Moscow), v. 46, no. 4, 1957 p 105–106
(Contract AF 19(628)-3880)
(T-R-427; AD-602180)

Preliminary results of observations made during the opposition of Mars in September 1956 are discussed. Included in these observations are the following: (1) an investigation of the optical properties of the vegetation of the various climatic zones; (2) brightness; (3) the polar cap; (4) the seas; (5) a comparison between the color of the seas and that of the continents; (6) water in the atmosphere and on the surface; and (7) the polarization of light reflected by various portions of the surface. I.v.L.

N64-28975* New Mexico State U., University Park Research Center
A PHOTOGRAPHIC OPTICAL SEMIDIAMETER OF VENUS
Bradford A. Smith Repr. from Astron. J., v. 69, no. 2, Mar. 1964 p 201–204 refs Previously Published as NASA-CR-56364; see N64-23992 16-29
(Grant NsG-142-61)
(NASA-CR-56364)

Measurements of the optical diameter of Venus are generally free from the usual systematic errors when such measurements are made of the illuminated crescent at phase angles approaching 180°. Fifty-four photographic images obtained within a few days of inferior conjunction in November 1962 were measured across the diameter connecting the geometric cusps. An optical semidiameter of $8''.486 \pm 0''.004$ (p.e.) at unit distance is found, and is in some disagreement with visual observations. A radius of 6,050 km for the solid globe of Venus and a resulting mean density of 5.25 g/cm^3 are inferred. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-27870* Electro-Optical Systems, Inc., Pasadena, Calif.
STUDY OF A FLIGHT EXPERIMENT OF SOLAR-CONCENTRATOR REFLECTIVE SURFACES Final Report, Jun.–Nov. 1963
J. T. Arnold, M. L. Dalton, D. P. Foote, H. D. Goodman, G. R. Griffin et al 1 Nov. 1963 350 p refs
(Contract NAS1-2880)
(NASA-CR-55893) OTS: $19.75 ph

This is a final report on a study program involving a flight experiment for the determination of the effects of space environment on the performance of solar concentrator reflective surfaces. The program included definition of the factors in space that will affect concentrator surfaces, the selection of concentrator surface samples for evaluation, and the analysis and prediction of the effects of a space environment on concentrator surfaces. Also reported are the work on the simulation of a space environment for ground tests and the designs of two complete satellite systems for testing concentrator samples in space. Author

N64-27875* Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE D.C. TO D.C. CONVERTER Second Tertiary Progress Report, 27 Sep.–26 Dec. 1963
John T. Lingle [1963] 48 p
(Contract NAS5-3441)
(NASA-CR-56450) OTS: $4.60 ph

Effort was directed toward simplification of the low input voltage converter regulator circuit, improving circuit performance, and providing overload protection. The synchronized power oscillator used previously was replaced by a simpler circuit that has an operating frequency proportional to input voltage. This change was made because it was determined that it is not necessary to synchronize the regulator at some multiple of the converter frequency; it is desirable to control the power transformer maximum flux density by making the converter operating frequency proportional to input voltage; and simplification of the circuit reduces size and weight and increases reliability. Breadboard tests with the simplified circuit showed improved performance. Efficiencies of the regulated converter have been increased to between 74% and 76.5% for 50-w outputs. There are indications that this efficiency can be increased by eliminating flexible leads between the transformer and the transistors and by selecting transistors with lower saturation voltages. Performance data to substantiate predictions of increased efficiency exist. Preliminary ambient temperature tests showed that the converter functions well over the required ambient temperature range, and operates well at temperatures much lower than required. Author

N64-27876 Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE D.C. TO D.C. CONVERTER First Tertiary Progress Report, 26 Jun.–26 Sep. 1963
John T. Lingle [1963] 62 p refs
(Contract NAS5-3441)
(NASA-CR-56451) OTS: $6.60 ph

The converter and regulator have been designed, components procured, and a breadboard constructed. The "add-on" pulse-width-modulation voltage regulator has been chosen in place of pulse width modulation of the converter rectification circuit. Preliminary breadboard tests have shown that the regulated converter efficiency design goal (at least 70% efficiency) has been met for most of the operating conditions. The results show that the converter efficiency ranged between 75% and 82%, and the regulator efficiency was over 90% for most of the operating range. The current feedback converter drive circuit is presently being modified so that the operating frequency will be directly proportional to the input voltage. The results show that voltage regulation is small for load variations, but some change occurs with input voltage fluctuations. Author

N64-27879* Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
SPACE ELECTRIC POWER SYSTEMS STUDY Second Quarterly Progress Report, Feb. 8–May 8, 1962
F. X. Dobler, C. L. Doughman, R. C. Fear, G. E. Gerecke, M. A. Geyer et al [1962] 265 p ref
(Contract NAS5-1234)
(NASA-CR-58051) OTS: $17.00 ph

The general objective of the study program is to develop parametric data for the generation, control, conversion, and transmission of electric power for space vehicles. The coolant temperature for the generator is between 500° and 1,500° F. The ratings to be studied are between 1 and 10 Mw. Voltage levels for the system are between 5,000 and 50,000 v d.c. The technical information compiled during this period covers generator designs for 2, 5, and 10 Mw over the voltage, temperature, and speed range; parametric data of generator weight and efficiency as a function of system rating; and parametric data of weight and efficiency for electrical conversion and control devices as a function of system rating. Author

N64-27886* Boeing Co., Seattle, Wash.
INSTALLATION OF SOLAR CELLS ON PHOTOVOLTAIC CONCENTRATING PANELS
J. E. Anderson 2 Aug. 1963 50 p refs
(Contracts NAS7-100; JRL-950270)
(NASA-CR-56777; D2-35167) OTS: $4.60 ph

This document describes the materials, quality assurance and handling procedures, engineering and facilities requirements, and manufacturing processes required for the fabrication of the concentrating photovoltaic panels. R.T.K.

N64-27887* Naval Ammunition Depot, Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report through 31 Jan. 1964
E. R. Pettebone [1964] 62 p
(NASA-CR-56474) OTS: $6.60 ph

Life-cycle test results for 5- and 10-cell packs are presented in tabular form. Test parameters included ambient temperatures of 0°, 25°, and 50° C; voltage limits of 1.55, 1.49, and 1.41 v per cell; and depths of discharge of 15% to 25%, 25% to 40%, and 15% to 25% at 0°, 25°, and 50° C, respectively. G.D.B.

N64-27892* Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE D.C. TO D.C. CONVERTER Final Progress Report, 26 Jun. 1963–26 Mar. 1964
John T. Lingle [1964] 119 p
(Contract NAS5-3441)
(NASA-CR-56883) OTS: $9.60 ph

Research and development effort was concentrated on the determination of the optimum design of transistor low-input-voltage converters to convert the low voltage power of new energy sources up to useful levels for space applications. This study showed that transistor low-input-voltage converter–regulators have the performance characteristics to efficiently convert the low-voltage power to a useful higher voltage. Initial investigations determined that a current feedback transistor power oscillator should be used to chop the low-voltage, high-current power to square wave a.c. and transform it to higher voltage. This circuit is superior because it maintains optimum efficiency throughout the load range and is virtually independent of input voltage changes and transistor parameter variations that may occur with temperature or from aging. It was determined that voltage regulation by pulse width modulation of the stepped up and rectified converter output provides the maximum efficiency consistent with system operation. Author

N64-27902* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS. GENERAL PERFORMANCE TEST OF GULTON INDUSTRIES, INC., 20.0 AMPERE HOUR SEALED CELLS
H. M. Schultz 16 Apr. 1964 40 p refs
(NASA Order W-11252-B)
(NASA-CR-58202; QE/C-64-5) OTS: $3.60 ph

This report gives the results of the characterization tests of five 20-ampere-hour size cells. These results include the following: (1) The cells were capable of withstanding the vibration, mechanical shock, and acceleration requirements. (2) The 50° C temperature imposed the primary limitations on the charge acceptance and discharge capacity of the cells. (3) The cells at 0° C were incapable of accepting a continuous overcharge rate of c/10 or higher as the maximum charge voltage limit of 1.55 volts/cell was reached prematurely. (4) Charging efficiency was limited by temperature. I.v.L.

N64-27908* Marquardt Corp., Van Nuys, Calif.
STUDY OF BIOCHEMICAL FUEL CELLS Fourth Quarterly Engineering Progress Report, 1 Feb.–30 Apr. 1964
George E. Ellis and Edward E. Sweeney 27 Apr. 1964 34 p refs
(Contract NASw-654)
(NASA-CR-56448; Rept.-25136) OTS: $3.60 ph

Investigations were conducted in pretreating human waste by adding selected microorganisms to sterilized (autoclaved) human wastes. The microorganisms selected were *Escherichia coli* and *Clostridium sporogenes*; reaction temperatures were maintained at 75° F or at 95° to 100° F. These organisms were not as effective as indigenous microorganisms in producing electrical power. The effect of bubbling the fuel-anolyte with inert gas was also evaluated, and it was found to be effective in increasing the anodic open-circuit current density. Bomb calorimetric determinations of the heat of combustion of lyophilized human feces indicated a value of about 4,600 calories per gram. Platinized platinum alloy screen (90% Pt–10% Rh) was found to be essentially as effective as platinized platinum foil for these reactions. The first experiment was conducted in which human waste is degraded by electrochemical energy. Results show that the cathode (nonbiological) reaction is rate determining. Author

N64-27913* Naval Ammunition Depot, Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report, 31 May 1964
[1964] 82 p
(Order W-11252-B)
(NASA-CR-56416) OTS: $8.10 ph

Results are presented of the life-cycling program conducted to evaluate the following cell types: General Electric 3 A.H., Gould 3.5 A.H., Sonotone 5 A.H., Gulton 6 A.H., General Electric 12 A.H., Gould 20 A.H., and Gulton 20 A.H. R.T.K.

N64-27914* Naval Ammunition Depot, Crane, Ind.
NICKEL CADMIUM TEST PROGRAM MONTHLY PROGRESS REPORT, 3 JANUARY 1964
E. R. Pettebone Jan. 1964 48 p
(NASA CR-56475) OTS: $4.60 ph

Tabular data are given for life-cycle tests of 5- and 10-cell packs at three ambient temperatures, voltages, and depths of discharge. G.D.B.

N64-27920 Marquardt Corp., Van Nuys, Calif.
EVALUATION OF HEAT EXCHANGER CONTAMINATION ALLEVIATION TECHNIQUES: MONOETHANOLAMINE INJECTION AND COOLANT INTERRUPTION Technical Documentary Report, 1 Oct. 1962–30 Nov. 1963
T. A. Sedgwick and A. J. Bird Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 24 Jan. 1964 95 p refs
(Contract AF 33(657)-10796)
(Rept.-6058; APL-TDR-64-47; AD-601514)

Tests were conducted with a small-scale heat exchanger system (designated tube element) to evaluate the effectiveness of two techniques to control heat exchanger fouling due to water vapor. The two techniques are the injection of liquid monoethanolamine into a humid airstream upstream from the heat exchanger and periodic removal of contaminant deposition by coolant fluid shutoff and melting of the frost by the incoming airstream. Monoethanolamine injection was effective in controlling the heat exchanger fouling due to water vapor and also in providing a means of removing the contaminant from the overall system. Analytical results and test results indicate that monoethanolamine is also effective in removing carbon dioxide, a second heat exchanger contaminant. The periodic removal of contaminant deposition by coolant interruption and melting of the frost by the incoming airstream was not competitive with other techniques that control fouling due to water vapor. Author

N64-27924* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE COMPOSITION AND THERMODYNAMIC PROPERTIES OF THE PRODUCTS OF CYANOGEN-OXYGEN COMBUSTION
Charles J. Schexnayder, Jr. Washington, NASA, Aug. 1964 55 p refs
(NASA-TN-D-2422) OTS: $1.50

The equilibrium composition and thermodynamic properties of the products of cyanogen-oxygen combustion at input mole ratios of C_2N_2/O_2 from 1/0.9 to 1/4.0, for pressures between 10^{-2} and 10^{2} atmospheres and temperatures from 2,000° to 6,000° K, are calculated by using a program developed for a high-speed electronic computer. The calculations are based on the existence of 11 gaseous species for the computation of the neutral-product concentration. The free-electron concentration is calculated separately by using the results of the computation for the 11 neutral species and 13 additional charge reactions. Flame temperatures at the different pressures and mixture ratios are obtained separately by using a heat-balance technique. In addition the neutral species and free-electron concentrations for a certain flame temperature, reactant mixture, and combustion pressure are obtained by graphical interpolation of the computer results to establish the variation in flame composition when the oxygen concentration is changed in the precombustion mixture. The thermodynamic data based on the neutral-species computation are presented in the form of Mollier charts for three input mixtures of cyanogen and oxygen. Author

N64-27929 Harshaw Chemical Co., Cleveland, Ohio Solid State Research Lab.
INVESTIGATION OF THIN FILM CADMIUM SULFIDE SOLAR CELLS Second Quarterly Technical Progress Report, 25 Feb.–25 May 1964
J. C. Schaefer, R. J. Humrick, and R. F. Belt May 1964 46 p refs
(Contract AF 33(615)-1248)
(AD-601459)

This report covers the research and development of large-area, flexible, lightweight, thin-film cadmium sulfide solar cells. The purpose of this investigation is the attainment of 5% efficient cells with power-to-weight ratios of about 50 watts per pound. Considerable emphasis has been placed on the development of the chemiplated or immersion technique for the barrier formation. The vacuum deposition of CdS on single crystal CdS has been performed to study effects of substrate perfection on the quality of the film. Solid-state reactions of CuCl and CdS were investigated in order to prepare more effective barriers. Indium-plated Mo substrates were utilized to provide ohmic contacts at the CdS substrate interface. Spectral response of electroplated and chemiplated cells as a function of time shows that the latter appear to be more stable in ordinary ambients. The use of SiO thin films on the top surface of the cells has led to a more stable cell in the presence of water vapor. Author

N64-27930* Magna Corp., Anaheim, Calif. Research and Development Div.
RESEARCH ON APPLIED BIOELECTROCHEMISTRY Final Report, 14 Mar. 1963–13 Mar. 1964
J. H. Canfield and B. H. Goldner 8 May 1964 122 p refs
(Contract NASw-623)
(NASA-CR-54077) OTS: $10.10 ph

Human urine and feces were investigated as sources of electrochemical fuels resulting from degradative microbial and enzymatic processes. *Bacillus pasteurii* was selected to produce ammonia from urinary urea; *Escherichia coli* and a mixed sewage culture were selected to yield hydrogen from fecal polysaccharides. Cellulase and lipase were considered for enzymatic pretreatment of feces to facilitate subsequent microbial action. Studies were performed under static and continuous flow conditions to evaluate electrochemical performance of ammonia produced by *B. pasteurii*. Author

N64-28005 Electro-Optical Systems, Inc., Pasadena, Calif.
APPLIED RESEARCH ON CONTACT IONIZATION THRUSTER. VOLUME III: POWER CONDITIONING, SWITCHING, AND CONTROL SUBSYSTEMS Final Report, Mar. 1963–Mar. 1964
D. Erway, H. Kempt, R. Stribling, and S. Fine Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1964 252 p refs
(Contract AF 33(657)-10980)
(APL-TDR-64-52; AD-601186)

Analytical and experimental studies were made of power conditioning for cesium contact ion thrusters and nuclear-electric power sources in the 300-kw range. Investigations included experimental determination of basic power requirements of thrusters and projected characteristics of large thrusters; survey and projection of the characteristics of large nuclear-electric space power systems; analytical studies of systems engineering problems such as environments of space, radiation tolerance of electronic parts, reliability of electronic parts, radiation shielding, and transmission lines; and preliminary design of power conditioning equipment for 300-kw system and scaling to 30-kw model. A 30-kw model of an electric propulsion system was fabricated, which included development and testing of 30-kw power conditioning breadboard; development and testing of electronic simulator of 30-kw thruster; and procurement and installing of 3200 cps, 40-kv power source to simulate nuclear turboalternator. Author

N64-28054 Atomics International, Canoga Park, Calif.
SNAP MERCURY RANKINE PROGRAM MERCURY CONDENSING EXPERIMENTS
R. P. Forslund 1 Aug. 1964 91 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9801) OTS: $1.85

An experimental study program of the various basic operating characteristics of mercury condensers for space applications is described. Included are techniques for predicting pressure drop in a variety of environments, condenser stability (both liquid leg stability and interface stability), the effects of noncondensibles, startup dynamics, and the differences between wetting and nonwetting condensing. Although the program is primarily based on obtaining accurate pressure-drop data in single horizontal tubes to simulate the zero-gravity of space operation, tilting and multitube capabilities are available. Existing models for predicting pressure are discussed. A description of the partially completed test facility is given, along with the basic requirements of various pieces of equipment necessary to obtain accurate data. Author

N64-28056* General Electric Co., Cincinnati, Ohio Missile and Space Div.
TWO STAGE POTASSIUM TEST TURBINE Quarterly Progress Report No. 12, Feb. 9–May 8, 1964
E. Schnetzer, ed. [1964] 145 p
(Contract NAS5-1143)
(NASA-CR-54115) OTS: $11.00

Research effort in the fluid-dynamics test program was divided between turbine potassium-performance test preparations and converging–diverging nozzle data evaluation. The turbine, without the nozzle diaphragms and casing, was fabricated and assembled for test. During testing, an oil leak occurred, and a program has been established to determine its cause. The 3,000-kw facility was prepared and is ready for testing the potassium turbine. The U-700 buckets for both stages of the turbine during pretesting with air and steam were examined metallographically and by hardness survey. The results of the examination revealed that all but three buckets are metallurgically suitable for further testing in potassium vapor, and they are being held in reserve for endurance testing. The results of an investigation to compare the degree of reaction of several lubricating oils with potassium as a function of temperature are presented. R.T.K.

N64-28078 Radio Corp. of America, Lancaster, Pa. Special Electronic Components Div.
RESEARCH STUDIES ON THERMIONIC CONVERTERS, EMITTER SHELL PHASE Quarterly Technical Report, 1 Jan.–31 Mar. 1964
M. N. Slater Apr. 1964 34 p refs
(Contract DA-36-039-AMC-03197(E))
(QTR-3; AD-601111)

The permeation of fossil fuel combustion gas was determined for alumina, beryllia, and silicon carbide using a prototype burner designed for this purpose. Supplemental tests were run using helium, argon, and nitrogen on alumina and hydrogen on silicon carbide. Alumina appeared to be the best barrier material of those tested. Alternate barrier-emitter systems were designed, including multilayer-coated molybdenum cups and a double-walled alumina–molybdenum assembly with helium-filled interstice. Four converters were constructed. Author

N64-28086* Union Carbide Corp., Parma, Ohio Parma Research Lab.
STUDY PROGRAM TO IMPROVE FUEL CELL PERFORMANCE BY PULSING TECHNIQUES Final Report
M. L. Kronenberg and K. V. Kordesch 28 Jun. 1964 47 p refs
(Contract NAS3-2752)
(NASA-CR-54150) OTS: $4.60 ph

This investigation was concerned with the effect of the modification of the gas–electrolyte interface on the performance of fuel cell electrodes. Modification of the interface was accomplished by subjecting the porous electrodes to electrical and mechanical pulses at subsonic and sonic frequencies. Hydrophobic and hydrophilic electrodes were used. Author

N64-28142 Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM: IN-PILE TEST OF PROTOTYPE ML-1 FUEL ELEMENTS
J. S. Brunhouse, A. B. Burgess, G. T. Geering, S. Nakazato, and G. W. Titus Jun. 1964 215 p refs
(Contract AT(10-1)-880)
(IDO-28616)

Prototype fuel elements of the design used in the first core loading of the ML-1 (mobile nuclear powerplant) reactor were tested in-pile. The IB-8T-1 (instrumented) test element operated for 6,415 hr in 99.5 wt% nitrogen with 0.5 wt% oxygen under ML-1 operating temperature conditions. Test data indicated that the fuel pin cladding temperatures were in excellent agreement with design calculations and that the element would operate at full power (55 kw) without exceeding the specified cladding hot spot temperature (1,750° F). Postirradiation examination of the IB-8T-1 test element revealed that the fuel pins were deformed by spiral bending; analysis indicated that this condition was the result of constraint imposed by the spacer wires during thermal growth of the fuel pins. The IB-8T-2 (uninstrumented) test element operated for 6,415 hr in oxygenated nitrogen plus 3,736 hr in air for a total of 10,151 hr. Performance of the element during the test was completely satisfactory. Postirradiation examination revealed excellent resistance of the Hastelloy X fuel pin cladding to oxidation by the gas, the maximum oxidation penetration observed was 0.0044 in. Author

N64-28158 Aeronautical Systems Div., Wright-Patterson AFB, Ohio
PRELIMINARY WEIGHT ESTIMATES FOR ADVANCED DYNAMICS ENERGY CONVERSION SYSTEMS
George D. Huffman Sep. 1963 111 p refs Presented at the ASD Sci. and Eng. Symp., Wright-Patterson AFB, Ohio, 18–19 Sep. 1963
(ASD-TDR-63-705; AD-425699)

This report presents an assessment of working fluids for use in a high-temperature dynamic power conversion system. The method of comparison of the various fluids consists of a preliminary design of the major system components. The results are presented as conversion system specific weights for the considered fluids—potassium, sodium, lithium, bismuth, and lead—at various values of turbine inlet temperatures. On the basis of the generated data, only potassium and sodium are practical for use as a working fluid in the temperature range of consideration, 2,000° to 4,000° R. Potassium and sodium at turbine inlet temperatures from 2,800° to 3,200° R offer systems of sufficiently low weight to warrant further and more detailed investigations. Author

N64-28221* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHELF LIFETIME OF GALLIUM ARSENIDE SOLAR CELLS
R. L. Johnston *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 5 p (See N64-28201 20-23) OTS: $19.75 ph

The following possible causes of a deterioration observed in the operating characteristics of some GaAs solar cells, during their shelf-life, were investigated: surface and volume hygroscopic effects; continued postmanufacture diffusion of the dopant; and poor electrical contacts. Results of the investigation indicated no correlation between the suggested causes and the deterioration of the GaAs solar cells. It is, therefore, concluded that some other phenomenon is responsible for the short shelf-life of some of the cells. I.v.L.

N64-28222* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPERATURE EFFECTS ON IRRADIATED SOLAR CELLS
B. T. Cunningham, R. L. Sharp, and L. Slifer *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 8 p refs (See N64-28201 20-23)
OTS: $19.75 ph

N/P and P/N solar cells were irradiated with 1-Mev electrons in dosages varying from 10^{11} to 10^{16} electrons/cm^2. The room-temperature characteristics of these irradiated cells were obtained after which temperature effects were studied. Open-circuit voltages varied linearly with temperature, between −75° C and 125° C, for both irradiated and nonirradiated silicon solar cells. The coefficient of open-circuit voltage change with temperature was −2.22 to −2.59 Mv/°C. Irradiation did not appreciably affect the coefficient of open-circuit voltage change with temperature for temperatures between −75° and 125° C. The degradation of short-circuit current and maximum power, due to irradiation at 10^{16} electrons/cm^2 was greater in P/N solar cells than in the N/P type, for temperatures between −100° and 125° C. The degradation of short-circuit current and maximum power caused by irradiation at 10^{16} electrons/cm^2, at temperatures between −100° and 100° C, was greater in N/P solar cells with a base resistivity of 1 ohm/cm than in the N/P cells with 10 ohm/cm base resistivity. There appears to be no significant difference between these two types of N/P cells in degradation of maximum power at temperatures from 100° to 125° C. I.v.L.

N64-28239 Yardney Electric Corp., New York, N.Y.
DEVELOPMENT OF THE SEALED ZINC-SILVER OXIDE SECONDARY BATTERY SYSTEM Quarterly Progress Report, 1 Jan.–31 Mar. 1964
Martin Sulkes and George A. Dalin [1964] 80 p refs
(Contract DA-36-039-AMC-02238(E))
(QPR-3; AD-436042)

Studies of the zinc–oxygen recombination reaction using a rotating disc electrode have shown that the reaction is kinetically controlled. The rate of recombination increases as the electrolyte concentration is lowered. The rate of recombination of hydrogen with AgO was found to be potential dependent. Data are presented on the physical, chemical, and electrical properties of separator materials. The addition of 1% Pd or Pb to a silver electrode of fine particle size increased Ag-1 utilization to 70% of theoretical. Ag-1 utilization was maximized by the use of 25% to 27% KOH. Author

N64-28287 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AIRCRAFT ELECTRICAL GENERATORS
A. I. Bertinov 20 Mar. 1964 695 p refs Transl. into ENGLISH of the book "Aviatsionnyye Elektrich-Eskiye Generatory" Moscow, Gos. Izd. Oboronnoy Prom., 1957 p 1–593
(FTD-TT-63-209/1+2; AD-601545)

The book discusses general questions of aircraft electrical machinery, the theory of general-purpose and special aircraft generators; analyzes domestic and foreign experience gained in the manufacture of aircraft electrical machinery; and discusses several new circuits. Author

N64-28291 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Tapco Div.
SNAP 8 ALTERNATOR. VOLUME 1: DEVELOPMENT PLAN
15 Apr. 1963 226 p refs
(ER-5301)

The magnetic design and the performance of the alternator are comparable to a conventional salient pole aircraft alternator. The detailed electrical design and performance are supported by years of development testing on alternators of the same basic design and construction. Proven, commercially available materials are used. The major development problem lies in the bearings, seals, and scavenge system. Although ball bearings may give the reliability required, the reliability of a bearing–vapor liquid seal combination is not well established. For this reason, an alternate bearing approach is offered. Integrated hydrodynamic bearings and seals have been operated in prototype turboalternator systems for more than 2,500 hr without performance degradation. Author

N64-28305* General Electric Co., Philadelphia, Pa. Space Sciences Lab.
OVERALL EFFICIENCY TRENDS IN A COAXIAL GUN PLASMA ENGINE SYSTEM
Bernard Gorowitz, Allen Ruess, J. Kenney, and P. Gloersen N.Y., AIAA [1964] 16 p Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Contract NAS3-03570)
(AIAA Paper-64-706) AIAA: $0.50 members, $1.00 nonmembers

The efficiency of conversion of capacitor-stored energy to energy in the exhaust stream of a repetitively pulsed two-stage coaxial plasma engine has been determined calorimetrically for various capacitances, voltages, gas densities and density profiles, and gun geometries. The efficiency trends observed have led to empirically determined optimum gun lengths, electrode radius ratios, and energy storage voltages. A B_θ probe was used to substantiate characteristics of coaxial gun current sheet behavior deduced from terminal measurements of current and voltage waveforms. Energy efficiencies of 55% have been measured so far, without having reached a leveling off of the efficiency increase trend. Author

N64-28373* Douglas Aircraft Co., Inc., Santa Monica, Calif. Life and Environmental Systems Section
AUXILIARY POWER GENERATING SYSTEM FOR A LARGE SPACE LABORATORY
A. D. Tonelli and T. C. Secord N.Y., AIAA [1964] 11 p refs Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(Contract NAS9-1688)
(AIAA Paper-64-719) AIAA: $0.50 members, $1.00 nonmembers

The results of a study of auxiliary power generating systems for a large 24-man space laboratory for the post-1970 time period are presented. Solar dynamic, nuclear SNAP 8, and solar cell-battery units were investigated as possible auxiliary power systems capable of generating 18 to 40 kw of electrical power. Trade-offs in weight, cost, reliability, solar area deployed, and/or radiator area were performed for the various systems. The power required for subsystem operation and experimentation was established at 27 kw. On the basis

of the trade-offs and the 27-kw design load, the solar dynamic Brayton system was recommended for the laboratory. Author

N64-28374* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ELECTRICAL POWER GENERATION SYSTEM REQUIREMENTS FOR A LOGISTICS SPACECRAFT
C. Dale Haines N.Y., AIAA [1964] 10 p Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(AIAA Paper-64-720) AIAA: $0.50 members, $1.00 nonmembers

The mission and vehicle requirements of a space-station logistics spacecraft, and other pertinent factors that influence the selection and vehicle integration of a power-generation system are examined. A 12-man, lifting reentry, horizontal-landing-type logistics spacecraft is arbitrarily selected for analysis, since it imposes unique constraints on the power system. This spacecraft would have the capability of transporting cargo and personnel to and from a manned, earth-orbiting space station and should provide for reentry, landing and recovery, and reuse. The mission duration selected for analysis includes 24 hours for ascent, 24 hours for descent, and a 1-day post-landing period. The orbital storage period is 6 months. Studies are presented that represent the combined analyses of energy-conversion devices and their related subsystems, such as thermal control, power conditioning, and reactant supply. An insight is given into the many interrelated factors that influence final power-system selection. I.v.L.

N64-28375* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
DESIGN STUDY OF SOLAR BRAYTON CYCLE CAVITY RECEIVERS WITH LITHIUM FLUORIDE HEAT STORAGE
R. A. Mc Kinnon, T. J. Vild, and J. A. Milko (NASA. Lewis Res. Center) N.Y., AIAA [1964] 16 p refs Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(Contract NAS3-2779)
(AIAA Paper-64-727) AIAA: $0.50 members, $1.00 nonmembers

The solar Brayton cycle cavity receiver–heat-storage program is discussed. This program consists of the following: (1) design analysis; (2) small-scale experiments; and (3) material corrosion tests. The object of the design analysis is to evolve a design layout for a receiver–heat-storage unit to meet the specifications of the NASA Lewis Research Center for a solar Brayton cycle system. The working fluid is argon gas. The purpose of the small-scale experiments is to determine engineering values of the design criteria needed for the complete design analysis. These criteria include the potential heat-flux rates from the cavity surface to the storage bath and the thermal conductivity of the solid lithium fluoride near the melting temperature. The material corrosion tests are intended to measure the corrosion resistance of several nonrefractory alloys exposed to molten lithium fluoride under cyclic temperatures. Progress to date is as follows: (1) A basic design concept for receivers has evolved. (2) Engineering values for the thermal conductivity of lithium fluoride, in solid and liquid states, near the melting point were determined. (3) Corrosion tests with lithium fluoride were conducted at temperatures up to 1,850° F. I.v.L.

N64-28408* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTS ON RADIANT ENERGY CONVERSION USING THIN DIELECTRIC FILMS
Benjamin H. Beam, Joseph F. Fry, and Larry D. Russell N.Y., AIAA [1964] 12 p refs Presented at AIAA 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(AIAA Paper-64-729) AIAA: $0.50 members, $1.00 nonmembers

The experiments described on radiant energy conversion using thin dielectric films in a thermoelectrostatic cycle indicate the following: (1) The manner of variations in measured power output with film thickness, frequency, and voltage corresponds with those expected on the basis of a theoretical thermoelectrostatic cycle. (2) The variation of dielectric constant with temperature, which appears to be operative in energy conversion in the five types of film on which tests were conducted, differs from that expected on the basis of conventional dielectric test techniques. (3) Of the five types of plastic film tested, all had essentially similar performance characteristics. Tetrafluoroethylene-hexafluoropropylene (FEP) demonstrated somewhat superior performance as a result of its better dielectric leakage characteristics at elevated temperatures. (4) The values of dielectric breakdown strength and leakage resistance that were found to limit performance in these tests were substantially below those expected from tests by others. Author

N64-28409* Goodyear Aerospace Corp., Akron, Ohio
SOLAR CONCENTRATOR DESIGN AND CONSTRUCTION
Thomas J. Mc Cusker N.Y., AIAA [1964] 8 p refs Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(Contracts NAS1-3301; NAS1-3140)
(AIAA Paper-64-733) AIAA: $0.50 members, $1.00 nonmembers

Effects expended in the development of fabrication techniques for the following types of solar concentrators are discussed: (1) inflation-formed concentrators; and (2) the cone-and-column concentrator. Also discussed are techniques for the ground and space rigidization of concentrators and the thermal coating of concentrator films. I.v.L.

N64-28410* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DEVELOPMENT OF HYDROGEN-OXYGEN FUELED 3-KILOWATT INTERNAL-COMBUSTION ENGINE
Harry M. Cameron and Norman E. Morgan (Vickers, Inc., Torrance, Calif.) N.Y., AIAA [1964] 12 p refs Presented at AIAA 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(AIAA Paper-64-756) AIAA: $0.50 members, $1.00 nonmembers

The objective of this program was to convert the high energy released by the combination of hydrogen and oxygen to useful power in a powerplant that had been well developed in conjunction with hydrocarbon fuels. The power package includes a single-cylinder engine, generator, gas compressor, and recuperator for transferring heat from the exhaust gases to the gaseous cryogenic propellants. The approach has been to design the test engine and other test components based on available engine technology and to proceed with experimental development based on the analysis of test results. Current development work on the engine is concerned with improving fuel consumption rates. Power levels from 1 to 5 hp have been achieved. Author

N64-28411* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
INVESTIGATION OF LIQUID MHD POWER CONVERSION

D. G. Elliot, D. J. Cerini, and E. Weinberg N.Y., AIAA [1964] 16 p refs Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(AIAA Paper-64-760) AIAA: $0.50 members, $1.00 nonmembers

The investigation of liquid MHD power conversion has led to the following conclusions: (1) An operating liquid MHD space powerplant using present reactor, liquid metal, and materials technology can be built. (2) An unshielded specific weight of 30 to 45 lb/kw appears attainable. The chief uncertainty is in achievement of 70% efficiency with MHD generators integrated with the separator and diffusers and providing a suitable output for power conditioning. (3) An operating life in excess of 1,000 hr seems certain from the materials testing to date, but insulator life remains to be demonstrated for longer times, especially under flow conditions. Author

N64-28412* United Aircraft Corp., East Hartford, Conn.
AN ENGINEERING EVALUATION OF ADVANCED NUCLEAR THERMIONIC SPACE POWERPLANTS
P. Bolan, R. Cohen, and G. Bordner N.Y., AIAA [1964] 8 p refs Presented at the 3rd Biennial Aerospace Power Systems Conf. Philadelphia, 1–4 Sep. 1964
(Contract NASw-360)
(AIAA Paper-64-766) AIAA: $0.50 members, $1.00 nonmembers

Initial study of a 1 Mw(e) in-pile nuclear thermionic space power system indicated a specific weight potential of 2.4 #/kw. As the preliminary design was refined to include practical converter dimensions, nonuniform emitter temperature effects, nonuniform reactor power distribution, power-conditioning equipment, launch vehicle integration, and detailed component and structure design, the specific weight increased to 25.6 #/kw. Author

N64-28508 Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
DESIGN, FABRICATION AND TESTING OF VENTED, RECHARGEABLE SILVER-CADMIUM CELLS Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. A. Harmyk and J. H. Brent, Jr. [1964] 17 p
(Contract DA-36-039-AMC-03359(E))
(Rept.-3; AD-601583)

The work accomplished pertained primarily to silver–cadmium cell design. Parts procurements were initiated, and all parts were ordered. Development testing was performed in order to determine the effect of discharge on the cell terminal, and a limiting discharge rate is recommended. R.T.K.

N64-28554 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
THE X-20 FLIGHT CONTROL SYSTEM DEVELOPMENT
Edward H. Mc Donald and Joseph A. Farris Jun. 1964 25 p
(Contract AF 33(657)-7132)
(SEG-TDR-64-8; AD-603704)

This report provides a summary of the unique features of the flight-control system developed for the X-20 (Dyna-Soar) vehicle. The documents in which these features are described in detail are referenced. The most significant problems encountered in the development of the features are discussed, together with the solution or the approaches being taken to obtain a solution. R.T.K.

N64-28575 Alfred U., N.Y. Catalysis Lab.
STUDY OF HYDROGEN-OXYGEN FUEL CELL ELECTRODES Technical Documentary Report, Jan. 1962–Jun. 1964
T. J. Gray and R. B. Rozelle Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab. [1964] 38 p refs
(Contract AF 33(657)-7564)
(APL-TDR-64-88; AD-603630)

A number of different types of fuel cell systems, including catalysts, electrodes, and electrolytes, have been investigated. Of the metals studied, it was found that a platinum–palladium electrically co-deposited catalyst gave the best performance at both the hydrogen and oxygen electrodes. Supporting data from single electrode studies and galvanostatic measurements are given. Experimental methods of depositing the catalyst were also studied. Ultrasonic impregnation of the electrode with the electroplating solution before electrodeposition produced, by far, the best electrochemical performance. Both porous carbon and sintered nickel were used as catalyst supports. Free electrolytes, various types of gelled electrolytes, and electrolytes held in an asbestos matrix were investigated. Wetting or contact difficulties dictated the use of aqueous potassium hydroxide–asbestos electrolyte in the final cells that were constructed. Author

N64-28648* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
NASA SOLAR CONCENTRATOR DEVELOPMENT
Atwood R. Heath, Jr. and Edward L. Hoffman N.Y., AIAA [1964] 8 p refs Presented at 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(AIAA Paper-64-730) AIAA: $0.50 members, $1.00 nonmembers

In summary, a description of the various NASA solar energy concentrator development projects is given. Investigations were made on several of the concentrators, and some results are indicated. In the area of one-piece concentrator development, 5-ft-diam stretch-formed aluminum and electroformed nickel concentrators were built that have sufficient concentration ability for high-temperature applications. The electroformed nickel concentrators are more efficient, but the stretch-formed aluminum concentrators are of lighter weight and could be considered for systems where weight is a critical factor. A 9 1/2-ft master was fabricated by the spin-casting process, and encouraging results were obtained. However, further development in the process appears necessary to bring the quality of concentrators fabricated from spin cast masters up to the advanced stage of the 5-ft-diam electroformed nickel concentrators. In the area of expandable concentrators, results were obtained on two concepts. First, the whirling membrane concept appears to be capable of efficient operation in the concentration range near 200. Second, a ground demonstration model of the cone-and-column concept has concentrator properties somewhat similar to those of other expandable concentrators. Finally, studies in progress on inflatable-rigidized concentrators have recently shown that this concept has promise.
Author

N64-28773 Thompson Ramo Woolridge, Inc., Cleveland, Ohio Electromechanical Div.
HIGH TEMPERATURE SOLAR THERMIONIC GENERATORS Technical Documentary Report, 15 Apr. 1963–31 Aug. 1964
Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 31 Aug. 1964 231 p refs
(Contract AF 33(657)-11169)
(TRW-ER-6044; APL-TDR-64-92; AD-350373)

The results of solar evaluations of a 100-w thermionic generator conducted under a solar flux range of 80 to 100

w/ft^2 are presented. Generator performance optimization, misorientation, cyclic, and transient response tests were accomplished. Good correlation of the generator's solar performance with laboratory performance was obtained and indicated that at the 130 w/ft^2 solar flux level of outer space, the generator would be capable of achieving the full design power output of 100 w. Generator power output was reduced up to 10% under a solar concentrator misorientation of 6 minutes of arc, illustrating the need for high accuracy concentrator orientation devices. In addition, results of cyclic and continuous life test of "practical hardware" thermionic converters are given for three design iterations (Series 2B, Series 300, and Series 310). Author

N64-28789 Naval Ordnance Lab., Corona, Calif. Research Dept.
CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS RESERVE BATTERY SYSTEMS Quarterly Report, Jan.–Mar. 1964
15 May 1964 25 p refs
(NAVWEPS-8193; AD-601912)

Experimental cell studies in the ionic melt system Mg/KSCN-NaSCN-kaolin/UO_3-electrolyte-C/Ni were completed. Significant improvement in cell voltage and discharge current was obtained by adding 10 wt % NaCl to the eutectic thiocyanate electrolyte and by using a 50 wt % Li-Mg alloy anode. Introduction of a small amount of Na_2S into the electrolyte gained a slight performance advantage. Calculations of theoretical energy densities of lithium-alloy anodes coupled with UO_3 electrodes showed that the 25 and 50 wt % Li-Mg/UO_3 couples are rated within 8 whr/lb of the maximum 252 whr/lb for Li/UO_3 (based on a $2e^-$ reaction). Melting points of prepared lithium alloys were found to range from 520° C for 25 wt % Li-Mg to 130° C for 80 wt % Li-Ca, as compared with 186° C for pure Li. New studies, which include electrical conductivity polarography, and chronopotentiometry, were begun on electrolytes with dimethyl sulfone solvent (mp 109° C). Author

N64-28849* Gulton Industries, Inc., Metuchen, N.J.
THERMAL ANALYSIS OF HERMETICALLY SEALED NICKEL-CADMIUM CELLS FOR SPACE APPLICATIONS
Karl E. Preusse and Robert C. Shair N.Y., AIAA [1964] 12 p Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964
(Partially sponsored by NASA)
(AIAA Paper-64-751) AIAA: $0.50 members, $1.00 nonmembers

The variation of the mean thermal conductivity of a nickel–cadmium cell was determined as a function of overcharge current and environmental temperature. Also determined was the effect of cell geometry on heat-transfer rates. Knowing the overcharge current and the environmental temperature, it is possible to determine the thermal conductivity, and to predict the thermal gradient in the cell and ultimately in a battery. Author

N64-28880* Marquardt Corp., Van Nuys, Calif.
STUDY OF BIOCHEMICAL FUEL CELLS Quarterly Engineering Progress Report No. 5, 1 May–31 Jul. 1964
G. E. Ellis [1964] 30 p
(Contract NASw-654)
(NASA-CR-58671; Rept.-25141) OTS: $2.60 ph

The purpose of this program was to conduct empirical studies on biochemical fuel cells for producing electrical energy through degradation of human waste. Research conducted during this quarter included effects of aerobic conditions in the fuel-anolyte, determination of limiting current densities, electrochemical activity of microorganisms isolated from human waste, comparison of fresh urine and frozen-reheated urine as a biofuel, reproducibility studies, use of electrochemical energy for degrading human waste, separation of chemical–biochemical from electrochemical fuel cell reactions, electrochemical activity of *Escherichia coli* on an amino acid, and electrochemical degradation of activated sludge. E.W.

N64-28899* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY INVESTIGATION OF A RADIOISOTOPE FUELED THERMIONIC DIODE POWER SYSTEM FOR THE 0.5 TO 3.0 KW POWER RANGE REQUIREMENTS ASSOCIATED WITH ELECTRIC PROPULSION DEVICES
Dennis F. Hasson Jul. 1964 50 p refs
(NASA-TM-X-55064; X-623-64-169) OTS: $4.60 ph

The use of radioisotopes as thermal sources in a thermionic diode power system has been investigated. The power system was envisioned to meet the requirements of electric propulsion devices in the 0.5- to 3.0-kw range. The diode loss and output, fuel block thermal, and system weight analyses utilized to obtain the system efficiencies and system performances (watts per pound) are presented. Also included are the resultant costs and electrical power availability analyses from the above information. Author

N64-28955* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT OF AN OPEN-CYCLE FUEL CELL SYSTEM Eighth Quarterly Report, 1 Apr.–30 Jun. 1964
J. Euclide, J. Ward, and W. Bruce 30 Jul. 1964 27 p
(Contract NAS-8-2966)
(NASA-CR-58313) OTS: $2.60 ph

Progress in the static vapor-pressure control studies is reported. The requirements for purging the inert impurities in the reactant gases from the cell are discussed. The results of tests on a mockup of a gas-cooled fuel cell system are presented. A description is included of the 28-v breadboard fuel cell system, and the initial test results are given. Author

N64-28957* Honeywell, Minneapolis, Minn. Military Products Group Research Dept.
ROCKET BOOSTER CONTROL. SECTION 9: TIME OPTIMAL CONTROL WITH AMPLITUDE AND RATE LIMITED CONTROLS
W. W. Schmaedeke 27 Nov. 1963 41 p refs
(Contract NASw-563)
(NASA-CR-58577; MH-MPB-1541-TR-9) OTS: $4.60 ph

Necessary conditions leading to a method for the determination of bounded control amplitude and amplitude rate time optimal control trajectories by backing out of the origin are developed. The backing-out procedure requires choosing the response time, the unaugmented system adjoint vector at the response time, the rate-limited control variable amplitudes at the response time, and the rate-limited control variable amplitudes at the initial time. A set of consistency conditions on the control variables are then used to determine the allowable control variable trajectories from a finite set of possibilities. The state trajectories including the state at the initial condition can be determined in the usual manner from the control variable trajectories. Author

N64-28978 Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Engine Lab.
AIRESEARCH MODEL GTCP100-52-1 POWERPLANT CALIBRATION AND EXTREME TEMPERATURE STARTING TESTS Phase C, Final Report

W. V. Stetz and J. P. Malriat [1963] 42 p refs
(NAEC-AEL-1767; AD-601860)

Powerplant calibrations, including JP-5R fuel consumption determinations, were conducted at compressor inlet air temperatures of 3°, 58°, and 130° F at 100% speed using shaft and compressed air loadings. Output was acceptable. Fuel consumption was determined also during noload operation at various steady state speeds at compressor inlet air temperatures of −22° to 130° F. Starting tests were conducted at test temperatures of −32° to +125° F using JP-4R and JP-5R fuels and 24 v 36-amp batteries. Starting was unsatisfactory at low temperatures due to exhaust flaming, excessive turbine out temperatures, and unstable operation. It was improved by reducing fuel flow, using a higher capacity electrical power supply, and employing warm fuel. Operation of the fuel metering control and the bleed air load valve was unsatisfactory at low temperatures. Improved turbine section durability is required. Author

N64-28992* Duke U., Durham, N.C. College of Engineering
REPORT ON FEASIBILITY STUDY OF LIQUID-METAL SWITCH
Thomas G. Wilson [1963] 25 p refs
(Grant NsG 152-61, suppl. 2-62)
(NASA-CR-58339) OTS: $2.60 ph

The report discusses the theory and principles of operation of a liquid-metal switch. Factors influencing the selection of the liquid metal and several physical configurations are presented. Experimental results for one particular configuration are included. Author

N64-29002* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THEORETICAL AND PRACTICAL ASPECTS OF SOLAR PRESSURE ATTITUDE CONTROL FOR INTERPLANETARY SPACECRAFT
James D. Acord and John C. Nicklas 15 May 1964 18 p refs
(Contract NAS7-100)
(NASA-CR-58534; JPL-TR-32-467) OTS: $1.60 ph

This report briefly covers the theory of photon momentum transfer to the exposed surfaces of a space vehicle, and gives an engineering derivation of the essential equations and parameters for dealing with the resulting forces in a practical manner. Various configurations of spacecraft equipment and control surfaces are examined as to magnitudes and directions of solar pressure torques and the necessary conditions for control. To illustrate the principles involved, a particular spacecraft configuration is chosen for further examination and analysis. Block diagrams and transfer functions are given for several control and damping-loop configurations. Some of the major system-integration considerations are discussed, with particular emphasis on a minimum-interface combination of the solar pressure control system with an impulsive mass-expulsion system. System parameter optimization by graphical parametric analysis is illustrated, with the combined impulsive–solar-pressure system as an example. Finally, some of the special considerations and peculiarities involved in mechanizing such a low-torque low-response control system are discussed. A practical, simple mechanization is presented to illustrate the salient points. Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see* 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-27884* Berne U. (Switzerland)
STUDIES ON THE RADIOACTIVE DATING OF THE LUNAR SURFACE Status report No. 3, 10 Jan. 1963–10 Jan. 1964
P. Eberhardt and J. Geiss Jan. 1964 9 p
(Grant NsG-157-61)
(NASA-CR-56792) OTS: $1.10 ph

The experimental studies on a system for the determination of rare gas isotope concentrations by remote-controlled operation were continued. Modifications in the rare gas and purification system resulted in smaller dimensions, reduced weight, and greater reliability. The experiments with the extraction system for four rock-samples and the development of valves were continued. In addition to the experimental and technical work, a theoretical study on the possibilities, significance, and limitations of dating lunar surface material is carried out. Author

N64-27917 Texas Nuclear Corp., Austin
ACTIVATION ANALYSIS FOR IMPURITIES IN BERYLLIUM Technical Documentary Report, Jan. 1, 1963–Jan. 31, 1964
I. L. Morgan, J. B. Ashe, J. T. Prud'homme, and T. C. Martin
Wright-Patterson AFB, Ohio, AF Materials Lab., May 1964 80 p refs
(Contract AF 33(616)-8160)
(ASD-TDR-62-1038, Pt. III, Vol. I; AD-601324)

A list of cross-section data and related information was compiled for total neutron cross sections and the reaction cross sections, (n,p), (n,α), and (n,2n) in the energy region around 14 Mev. A gamma-ray spectral atlas containing 54 sets of spectra of some of the more common elements in the periodic table was obtained by activation analysis with 14.8-Mev neutrons. A 1- and a 5-minute irradiation of each element was made and spectra recorded at various times after irradiation to emphasize decay characteristics of the radioactive products from the irradiated element. Gamma-ray peaks from the reaction products were identified as well as radioactive decay products from trace impurities in each element whenever possible. Carbon and nitrogen surface contamination of several high purity beryllium samples was measured by proton irradiation. The results seem to indicate that a large percentage of this contamination is in surface layers suggesting that these contaminants may have been added during a machining process. Author

N64-27919 Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
EVALUATION OF AMMONIUM NITRATE, ALUMINUM MIXTURE (80/20)
Louis J. Montesi and Vincent J. Menichelli 14 May 1964 41 p
(NOLTR-64-63; AD-601527)

An investigation of the chemical and physical properties of an ammonium nitrate–aluminum (80/20) mixture was made. The sensitivity of the material to electrical, mechanical and thermal stimuli was determined. Other physical and chemical characteristics such as detonation rate, vacuum stability, and compatibility with various metals were also determined. Although the mixture tested was less sensitive than many high explosives, the data as a whole were such as to lead to the conclusion that this material should not be used in electroexplosive devices. Author

N64-27944* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
STUDY OF CARBONATE IMPURITY IN SURFACE REGION OF SODIUM CHLORIDE CRYSTALS
Dumas A. Otterson and Myron O. Davies Washington, NASA, Aug. 1964 14 p refs
(NASA-TN-D-2434) OTS: $0.50

Anionic impurities in the surface region of sodium chloride crystals were investigated by a nondestructive mass spectrometric method of analysis. This preliminary study indicated that moist carbon dioxide reacted with the salt surface and that the reaction was influenced by the conditions of the crystal surface. The reaction product, thought to be bicarbonate, was readily removed by treatment with water vapor or moist hydrogen chloride at an elevated temperature. The general method of analysis was capable of detecting carbonate (or bicarbonate), nitrate (or nitrite), and chlorate ions. Author

N64-27956 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
CELLULOSE NITRATE-ACETATE MIXED ESTERS
Yvon P. Carignan and Jack Bobinski Jun. 1964 70 p refs
(PA-TR-3105; AD-602750)

A preliminary investigation of the preparation and properties of cellulose nitrate–acetate mixed esters was conducted. These mixed esters can be prepared in a wide range of substitutions of both acetate and nitrate groups either through acetylation of cellulose nitrate or nitration of cellulose acetate. The degree of polymerization of the products, as estimated from viscosity data, shows the occurrence of chain degradation for both procedures. The hygroscopicity of the cellulose nitrate–acetate esters was found to be a linear function of total substitution. Films prepared from these mixed esters showed tensile strength at least comparable to that of films of cellulose nitrate or cellulose acetate. The impact sensitivity of the mixed esters varied from 6 to 18-in. for a 2-kg weight depending on the substitution of nitrate groups. Author

N64-27959* Naval Research Lab., Washington, D.C. Metallurgy Div.
PHOTOGRAPHIC X-RAY FLUORESCENCE DATA FOR FIXED-CRYSTAL CAMERAS Interim Report
A. J. Pollard 18 May 1964 12 p ref
(NRL-6096; AD-601530) OTS: $0.50

A compilation was made of X-ray fluorescence data obtained through the use of a novel fixed-crystal evacuated camera. These data will be of use whenever fixed sodium chloride crystals are used as diffractors for photographic devices of this type. From the tables presented, it is possible to identify 51 of the common elements. Author

N64-27961 Space Technology Labs., Redondo Beach, Calif.
RESEARCH ON CHARGED COLLOID GENERATION Final Report, Apr. 1963–Mar. 1964
E. Cohen Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jun. 1964 112 p
(Contract AF 33(657)-10999)
(APL-TDR-64-75; AD-601390)

The experimental research involved in the electrical-dispersion-of-liquids technique of generating a charged colloid beam is described. Charge–mass ratios were obtained by using a quadrupole focusing mass spectrometer during the single capillary tube stage of the work. When multiple needles were operated in parallel to increase the beam current, time-of-flight measurements replaced the quadrupole spectrometer. Data are presented both for the results obtained with single capillary tube operation and for the operation of many tubes in parallel. Author

N64-27970* Florida State U., Tallahassee
SYNTHESES OF α-AMINO ACID MENTHYL ESTERS
Kaoru Harada and Tadao Hayakawa Repr. from Bull. Chem. Soc. Japan (Tokyo), v. 37, no. 2, 1964 p 191–194 refs
(Grant NsG-173-62)

A new method of preparing α-amino acid menthyl esters is described. The method involves a direct esterification of α-amino acids with menthol, using a Dean and Stark distillation tube in azeotropic distillation. The p-toluenesulfonic acid was used as a catalyst, and benzene or a benzene-toluene mixture was used as the solvent. The α-amino acid menthyl esters thus prepared were isolated as hydrochlorides; they are abbreviated as amino acid M. HCl. Author

N64-27971 Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center
SEPARATION OF THE LANTHANIDE SERIES AND YTTRIUM USING PHOSPHONIC AND IMINODIACETIC ACID RESINS
J. O. Winget 1964 19 p refs
(BM-RI-6510)

Phosphonic acid and iminodiacetic acid chelating resins were investigated to assess their potential as selective ion exchangers for separating lanthanide elements and yttrium. The affinity of phosphonic acid resin for lanthanides increases with increasing atomic number, and that of iminodiacetic acid resin for lanthanides increases with atomic number to a maximum for element 62 and then declines with atomic number throughout the remainder of the series. Elution sequences of the elements with mineral acid eluants corresponded favorably with equilibrium data, whereas the elution sequence obtained with chelating eluants was proportional to the relative values of the stability constants of the chelating agents with the lanthanides. Separation of lanthanide mixtures into groups of light and heavy elements with iminodiacetic acid resin appears feasible. Author

N64-27972 Sandia Corp., Albuquerque, N.Mex. Sandia Lab.
MOLECULAR WEIGHTS OF MACROMOLECULES FROM VISCOSITY MEASUREMENTS
J. P. Burger Aug. 1964 12 p refs
(SC-DR-64-978) OTS: $0.50

The intrinsic viscosities [N] of a group of macromolecules (polysiloxanes) were determined in benzene solution, and a relationship between these values and the viscosity-average molecular weights $\bar{M}_v$ was established with the Mark–Houwink equation $[N] = K\bar{M}_v^a$. Author

N64-28019 Los Alamos Scientific Lab., N. Mex.
THE RADIOCHEMICAL PURIFICATION OF EUROPIUM AND A STUDY OF THE NUCLEAR PROPERTIES OF Eu^{157} Eu^{158}, AND Eu^{159}

W. R. Daniels 7 Aug. 1964 168 p refs
(Contract W-7405-ENG-36)
(LAMS-3104)

Chemical procedures were developed for the rapid preparation of radiochemically pure europium sources from rare-earth mixtures and from fission products. Unpurified mixtures of the monoester and di[p(1,1,3,3-tetramethylbutyl)phenyl] esters of orthophosphoric acid were used to extract rare earths in the (III) oxidation state away from europium in the (II) oxidation state. A slower chemical procedure for the preparation of europium sources that are both radiochemically pure and mass free has also been developed. The radiations of Eu^{157}, Eu^{158}, and Eu^{159} were studied by beta-ray and gamma-ray scintillation spectrometry. In addition, a search was made for the existence of isomeric states of Eu^{156}, Eu^{158}, and Eu^{160}. R.T.K

N64-28024 Los Alamos Scientific Lab., N. Mex.
THEORETICAL STUDIES OF ION EXCHANGE WITH SLOW PARTICLE DIFFUSION
R. S. Cooper and D. B. James 30 Jul. 1964 75 p refs
(Contract W-7405-ENG-36)
(LA-3046) OTS: $1.75

Several aspects of ion exchange with slow particle diffusion are examined with a view toward understanding the behavior of plutonium in ion-exchange columns. A numerical solution was developed that can include the effects of the nonlinear isotherm, the very low and variable solid diffusion coefficient, interaction between sorbed ions in the resin phase, and corrections for film and longitudinal diffusion in the solution. An analytic time-dependent solution for column operation with irreversible equilibrium is developed for several approximations to the diffusion process. This solution does not make the usual quasi-steady state assumption. Finally, diffusion into a sphere is examined in an attempt to match the experimental data for plutonium with Dowex 1X4 resin. Author

N64-28037 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF MECHANICAL DESTRUCTION OF GELATINS BY ELECTROPARAMAGNETIC RESONANCE
G. V. Abagyan and P. Yu. Butyagin *In its* Soviet Res. in Biophys. 30 Jul. 1964 p 39–47 refs (See N64-28034 20-16) OTS: $4.00

The mechanical destruction of gelatins was studied in a vacuum and in air at −196° C and at room temperature. By the EPR method, the destruction products revealed high concentrations of free radicals. Processes of migration of free valences and the connection of oxygen to free radicals were shown. The EPR spectra were measured on a d.c. radiospectrometer with dual magnetic modulation and a carrier frequency of 9,700 cycles per second. By these measurements, the first derivative was recorded along with the absorption curve. The concentrations of free radicals was estimated by comparison with the spectrum of the stable radical diphenylpicrylhydrasil (DPPH). R.T.K.

N64-28041 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 100
30 Jul. 1964 81 p refs Transl. into ENGLISH of Selected Articles from K'o Hsueh T'ung Pao (Peiping), no. 4, 1964 (JPRS-25656; TT-64-31928) OTS: $3.00

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6. A DYNAMIC ANALYSIS OF THE DEVELOPMENT OF CUMULO-NIMBUS INCUS L. Hsing-Cheng, C. Chi-P'ing, H. Yin-ch'iao p 59–62 refs (See N64-28047 20-21)

7. THE CHARACTERISTICS OF SEISMIC PHASES Pt AND St M. Shih-Jung p 63–70 refs (See N64-28048 20-12)

8. RESEARCH ON THE DUAL CHARACTERISTICS OF ACID ELECTRON CATALYSTS. IV. THE SURFACE AND ISOMERIZATION CHARACTERISTICS OF PLATINUM-SILICON-ALUMINUM H. Kuang-yen, L. Ch'un-yang, C. Hsueh-wen (See N64-28049 20-07)

N64-28043 Joint Publications Research Service, Washington, D.C.
CATALYTIC ACTIVITY OF RARE-EARTH COMPOUNDS IN DIRECTED POLYMERIZATION
Shen Chih-Ch'uan, Kung Chung-yuan, Chung Ch'ung-Ch'i, and Ou-Yang Chun *In its* Transl. on Communist China's Sci. and Technol. No. 100 30 Jul. 1964 p 23–28 refs (See N64-28041 20-07) OTS: $3.00

Rare earth elements belong to the IIIA family of transitional metals in the periodic table. The haloid compounds of the rare earth elements can combine with aluminum alkide to form a bimetallic complex compound (Ziegler-type catalyst) that has catalytic activity on the additive polymerization of alkanes. Research reports on the use of rare earth compounds as catalysts of directed polymerizations, with the exception of linear polymerizations of ethene, were not found up to now. Research covered in this report was on the catalysis of the catalytic system formed by rare earth compounds and aluminum alkide on the directed polymerization of butadiene. Some catalytic systems have a very high directedness. Polymerization was carried out under the conditions wherein small quantities of oxygen and some moisture were extracted. The benzene (analytically pure) solution of butadiene (purity, 99% mole) flowed past the activated aluminum oxide sticks to get rid of the moisture and other impurities. Author

N64-28044 Joint Publications Research Service, Washington, D.C.
SOME DISTRIBUTION CHARACTERISTICS OF SELENIUM AND TELLURIUM IN PURE PYRITE ORE DEPOSITS
Liu Ying-Chun and Chu Ping-Ch'iu *In its* Transl. on Communist China's Sci. and Technol. No. 100 30 Jul. 1964 p 29–38 refs (See N64-28041 20-07) OTS: $3.00

The mineral zone is situated at the southeast of a depression. The region is a monoclinal structure, primarily of the Jurassic Hsiang-shan type, whose stratum contains the ore. The ore deposits exist in the interbeddings of fine sand, efforescent sandstone, and shale containing feldspar and calcium. The mineral composition of the ore is comparatively simple, primarily of pyrite. Moreover, small quantities of cellular pyrite, arsenopyrite, chalcopyrite, sphalerite, magnetite, and hematite

are contained, as well as gangue minerals including quartz, calcite, sericite, chlorite rock, dolomite, and kaolinized soil. The ore-formation activities of the deposit are of many stages, with the formation closely related to the rift structure and the characteristics of adjoining rocks. Author

N64-28046 Joint Publications Research Service, Washington, D.C.
P-PHENYL AND BENZYL PHOSPHONIC ESTER
Yuang Ch'eng-yeh, Yeh Wei-chen, Ko Ming-chuan, and Chou Li-ying *In its* Transl. of Communist China's Sci. and Technol. No. 100 30 Jul. 1964 p 51–58 refs (See N64-28041 20-07) OTS: $3.00

This article reports on the formation of p-phenyl phosphonic ester, its substitute radical, and the characteristics of ester-alkyl radicals, as well as the influences on variation from layer analyses on testing paper, gram-molecular refractivity, characteristic frequency of the infrared spectrum, Lewis alkalinity, and hydrolysis speed. These characteristics and structural parameters of the compounds are conducted in a discussion of quantitative relationships. The results are helpful in explaining the cyclobenzene and phosphine-oxygen bonds in the molecules of phenyl phosphoric acid, and in discussing the structure of phosphine-oxygen bonds. Author

N64-28049 Joint Publications Research Service, Washington, D.C.
RESEARCH ON THE DUAL CHARACTERISTICS OF ACID ELECTRON CATALYSTS. IV. THE SURFACE AND ISOMERIZATION CHARACTERISTICS OF PLATINUM–SILICON–ALUMINUM
Hsi Ao Kuang-yen, Liu Ch'un-yang, and Chin Hsueh-wen *In its* Transl. on Communist China's Sci. and Technol. No. 100 30 Jul. 1964 p 71–78 refs
(See N64-28041 20-07) OTS: $3.00

This report describes the reaction characteristics, surface characteristics, and the poisoning effect for the isomerization of platinum–silicon–aluminum of different aluminum contents. In the manufacturing method for catalysts, grains of baked silicon–aluminum are immersed in a platinum chlorate solution at room temperature. Then the grains are dried at 110° C to produce platinum–silicon–aluminum with different contents of aluminum oxide, but with the platinum content consistently at 0.5% in weight. Two sodium poisoning methods are described. Author

N64-28065 General Electric Co., Cincinnati, Ohio Flight Propulsion Div.
THE METHOD FOR CHEMICAL ANALYSIS OF NITROGEN IN POTASSIUM
H. Kirtchik and S. Melzer 16 Sep. 1963 47 p
(R63FPD302)

A modified Kjeldahl method was developed for the determination of nitrogen in potassium. It involves the transfer of the alkali metal from a special sampling system to a unique distillation apparatus under argon and hexane, where dissolution is effected in phosphoric acid solution. Author

N64-28107 Bureau of Mines, Berkeley, Calif.
THERMODYNAMIC PROPERTIES OF CUPROUS AND CUPRIC FERRITES
R. Barany, L. B. Pankratz, and W. W. Weller 1964 23 p refs
(BM-RI-6513)

Experimental determinations were made of the heats of formation of cuprous ferrite and cupric ferrite at 298.15° K; the heat capacity of cuprous ferrite was measured over the temperature range from 50° to 298° K and the entropy at 298.15° K was evaluated; the heat contents of cuprous ferrite and cupric ferrite above 298.15° K were measured to 1,500° and 1,100° K, respectively. These thermodynamic values were combined with other pertinent data to obtain heat and free energy of formation values at high temperatures. The stability of the two ferrites with respect to their constituent oxides is discussed. Thermodynamic values are included for the decomposition of cupric ferrite to form cuprous ferrite, magnetite, and oxygen. Author

N64-28116 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
THE MELTING OF MIXED POLYETHYLENES [DAS SCHMELZEN VERMISCHTER POLYATHYLENE]
H. J. Orthmann and K. Ueberreiter Sep. 1962 17 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 61, 1957 p 106–113
(TIL/T.5331)

The effect of a solid diluent on the melting behavior of polyethylene was investigated, using mixtures of polyethylene with hexachlorodiphenyl, naphthalene, anthracene, n-C_{28} and the paraffins n-C_{110} and n-C_{28}, respectively. Characteristics of the melting phase diagrams are discussed, and methods of calculating intervals and lengths of amorphous regions by the Flory equations are described. Author

N64-28133 Bureau of Mines, Berkeley, Calif. Berkeley Thermodynamics Lab.
HEATS OF FORMATION OF ZIRCONIUM CARBIDE AND HAFNIUM CARBIDE
Alla D. Mah 1964 12 p refs
(BM-RI-6518)

The energies of combustion of zirconium carbide and hafnium carbide were measured by combustion calorimetry, and the heats of combustion and formation of zirconium carbide and hafnium carbide were derived. The results are as follows: ZrC—$\Delta H_{298.15}$ (combustion) = −308.60 ±0.55 kcal/mole, and $\Delta H_{298.15}$ (formation) = −47.0 ±0.6 kcal/mole; HfC—$\Delta H_{298.15}$ (combustion) = −306 08 ±0.20 kcal/mole, and $\Delta H_{298.15}$ (formation) = −52.3 ±0.4 kcal/mole. Author

N64-28149 Technische Hochschule in Graz (Austria)
STUDIES OF PREPARATION AND PROPERTIES OF ALKALI AZIDES AND BARIUM AZIDE AND EFFECTS OF THIS ACTIVITY ON THERMODYNAMIC AND THERMOCHEMICAL DATA Monthly Technical Status Report, 1–31 May 1964
Karl Torkar 10 Jun. 1964 10 p refs
(Contract DA-91-591-EUC-3320)
(MTSR-1; AD-442934)

By varying the position of the adsorbed CO_2 molecules at a 001 plane of sodium azide a maximum of total adsorption energy of −8.4 kcal/mol adsorbed CO_2 was obtained. Of this figure, −1.6 kcal/mol correspond to dispersion energy and −5.6 kcal/mol to multipole-multipole interaction energy; induction energy was estimated as 14% of the total energy, i.e., −1.2 kcal/mol. Comparing the value thus obtained with that of −9.6 kcal/mol, found by experiment, it is concluded that the difference between the two values is probably due to the idealized assumptions. Nevertheless, the result clearly shows that at temperatures in the range of about −70° C there is no chemisorption. As only insignificant adsorption effects occurred at room temperature, chemisorption can be excluded for this range, too. At temperatures of thermal decomposition, however, there is a high probability of chemisorption. Author

N64-28152 Technische Hochschule in Graz (Austria)
STUDIES OF PREPARATION AND PROPERTIES OF ACTIVE ALKALI AZIDES AND BARIUM AZIDE AND EFFECTS OF THIS ACTIVITY ON THERMODYNAMIC AND THERMOCHEMICAL DATA Monthly Technical Status Report, 1–30 Jun. 1964
Karl Torkar 13 Jul. 1964 11 p ref
(Contract DA-91-591-EUC-3320)
(MTSR-2; AD-445038)

An essential requirement for the decomposition of sodium azide is the existence of an interface metal azide at which the process of electron transfer can take place. If sodium azide is decomposed in a high vacuum, the sodium of the nuclei will evaporate because of the large average free path and condensate on the colder parts of the apparatus. Thus sodium on the crystal surface evaporates, owing to its relatively high vapor pressure at the decomposition temperature (0.1 torr at 350° C). If the metal evaporates very quickly, the electron transfer will be delayed. In presence of inert gases the average free path of the sodium atoms is reduced to such an extent that the evaporation effect is very strongly diminished. Author

N64-28181 Naval Ordnance Test Station, China Lake, Calif. Nicholson Lab.
A REVIEW OF THE KINETICS AND MECHANISM OF THE PYROLYSIS OF HYDROCARBONS
Alvin S. Gordon *In* AGARD Combust. and Propulsion 1963 p 111–137 refs (See N64-28176 20-11) Pergamon: £7

The paper reviews the kinetics and mechanisms of the pyrolysis of saturated hydrocarbons, including cycloalkanes, and of unsaturated hydrocarbons, olefins, and aromatics. It deals also with the effects of pyrolysis inhibitors and catalysts and with the influence of surfaces on pyrolysis reactions. Author

N64-28244 Union Carbide Nuclear Co., Oak Ridge, Tenn.
DETERMINATION OF URANIUM IN ALUMINUM
G. S. Petit, J. E. Mc Call, and C. A. Kienberger 19 Aug. 1964 10 p refs
(Contract W-7405-ENG-26)
(K-1524) OTS: $0.50

A short method was developed for determining trace quantities of uranium in aluminum. The aluminum is dissolved in hydrochloric acid, and the uranium is extracted into tri-n-octylphosphine oxide (TOPO) dissolved in benzene. The uranium is recovered with an ammonium oxalate solution, ammonium hydroxide is added, and the yellow uranium complex is developed with hydrogen peroxide. The absorbancy is measured in a spectrophotometer at 410 mμ and compared with that of a standard. The precision of a single analysis is ±8% of the value (100 to 500 ppm) at the 95% confidence level, and there is no significant bias. An analysis can be made in 1 1/2 hours. Author

N64-28249 Bureau of Mines, Boulder City, Nev.
SOLUBILITY CHARACTERISTICS OF SODIUM ALUMINATE
R. V. Lundquist and H. Leitch 1964 24 p refs
(BMARI-6504)

Sodium aluminate is the principal aluminum compound formed in the sinters prepared by the lime-soda sinter process for recovering aluminum from silicate source materials. The properties and characteristics of this compound were studied to improve the efficiency of the process. Crystalline sodium aluminate was prepared by sintering stoichiometric quantities of soda ash and calcined alumina for 1 hr at 1,250° C. The extent of aluminum extraction from sodium aluminate was determined in water and in solutions of NaOH and Na_2CO_3. Nearly complete extraction of aluminum from sodium aluminate was achieved only in solutions containing free NaOH in excess of that supplied by the salt through hydrolysis. About 42.2% to 68.8% of the aluminum was extracted in water or in solutions of Na_2CO_3. The precipitation of alumina trihydrate from sodium aluminate solutions was part of a continuous, reversible reaction according to the equation $Al(OH)_4^- \rightleftarrows Al(OH)_3 + OH^-$. The reverse reaction dissolves alumina trihydrate in NaOH solutions to produce sodium aluminate. Approximate equilibrium concentrations were determined for the reaction at 30°, 50°, and 70° C. False apparent equilibrium conditions for the disolution reaction appear when only a small excess of alumina trihydrate is present in the NaOH solutions. A large excess of alumina trihydrate must be present before the true equilibrium point is assured. The engineering significance of the data is summarized, showing controls that should be exercised for a successful and efficient process. Author

N64-28285 FMC Corp., Princeton, N.J. Chemical Research and Development Center
QM ELASTOMER CONTRACT Progress Report II, Sep. 27–Dec. 26, 1963
J. A. Gannon 9 Jan. 1964 13 p ref
(Contract DA-19-129-AMC-1147(N))
(PCR-349; AD-602530)

Reaction of dimethylchlorosilane with 3, 4, 4 trifluoro-4-bromo-3 chlorobutene-1 on a 0.5-mol scale at 75° C in the presence of chloroplatinic acid catalyst provided a 44% conversion to the adduct, $Cl\text{-}Si(CH_3)_2CH_2CH_2CFClCF_2Br$. Repetition of the reaction on a 5-mol scale was started, and the product obtained will be hydrolyzed and dehalogenated to form the desired disiloxane monomer, $(CF_2{=}CFCH_2CH_2Si(CH_3)_2)_2\text{-}O$-. Author

N64-28297 Little (Arthur D.) Inc., Cambridge, Mass.
THE DETERMINATION OF THE GEOMETRY OF HIGH-TEMPERATURE SPECIES BY ELECTRIC DEFLECTION AND MASS-SPECTROMETRIC DETECTION. STUDY OF HIGH TEMPERATURE THERMODYNAMICS OF LIGHT METAL COMPOUNDS Interim Technical Report
Alfred Buchler, James L. Stauffer, and William Klemperer (Harvard U.) 30 Jun. 1964 33 p refs
(Contract DA-19-020-ORD-5584; ARPA Order 40-62)
(ITR-7; AD-443399)

The electric deflection of mass spectrometrically detected molecular beams has been used to study the molecular geometry of high-temperature species by determining whether they possess permanent dipole moments or not. By this means, the following have been shown: (1) The lithium halide dimers are planar. (2) Lithium oxide, Li_2O, is linear. (3) The beryllium and magnesium dihalides are linear; the barium dihalides are bent. (4) The Group IIB dihalides are linear. (5) The dihalides of the transition metals from manganese through copper are linear. (6) The lead dihalides are bent. Both PbI and PbI_2 were found in lead iodide vapor. Author

N64-28349 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS OF CHEMICAL CYBERNETICS
G. N. Kobalev, L. A. Rastrigin, and Ya. P. Stradyn *In its* Simulation and Control of Phys. and Chem. Systems 20 Aug. 1964 p 21–41 refs

The problems of the use of cybernetic methods in chemistry and the chemical industry are examined from general positions, and an attempt is made to formulate certain basic

problems. The article is somewhat like an outline and attempts to acquaint the reader with chemical cybernetics. Author

N64-28350 Joint Publications Research Service, Washington, D.C.
ZINC, COPPER, COBALT AND MOLYBDENUM IN SOME SOILS IN THE EUROPEAN PART OF THE USSR
Yu. I. Dobritskaya, Ye. G. Zhuravleva, L. P. Orlova, and M. G. Shrinskaya 20 Aug. 1964 33 p refs Transl. into ENGLISH from the book "Mikroelementy v Nekotorykh Pochvak SSSR" Moscow, 1964 p 85–113
(JPRS-26040; TT-64-41310) OTS: $2.00

The data obtained from analysis of soil samples collected on an excursion from Moscow to the Crimea indicate that the content and distribution of trace elements in soil profiles depend largely on the character of the source rocks. Further differentiation of trace elements according to the type of soil strata, as well as the amount of biological accumulation, is noted. A low absolute content of active zinc, copper, and cobalt is most often observed in lighter and carbonate soils, whereas the activity of molybdenum increases in neutral and alkaline soils. A relatively high content of active trace elements in the upper humic strata correlated with a gradual reduction in the lower strata of the profile was found to be characteristic for almost all types of soils. M.P.G.

N64-28353* Massachusetts Inst. of Tech., Cambridge.
VARIATION OF STRONTIUM ISOTOPES IN TEKTITES
C. C. Schnetzler and W. H. Pinson, Jr. Repr. from Geochim. Cosmochim. Acta, v. 28, 1964 p 953–969 refs Previously Published as NASA-TM-X-51168; See N64-11339 02-15
(Grant NsG-222-61; Contract AF 19(604)-6135)
(NASA-RP-292)

The rubidium, strontium, and strontium isotopic compositions were determined in tektites from Indochina, Philippine Islands, Java, Australia, Texas, Georgia, Massachusetts, and Czechoslovakia. The range of Sr^{87}/Sr^{86} ratios in 18 tektites is from 0.7121 to 0.7223, indicating the results of Pinson *et al*, reporting no radiogenic strontium in tektites, were not of sufficient precision to study the problem definitively. This range of Sr^{87}/Sr^{86} ratios is quite small compared to the range found in nature, in general agreement with previous studies of oxygen and silicon isotopes in tektites. Rb and Sr contents of tektites from a given locality are very similar, but differences exist between localities. There is indicated, however, a sympathetic variation of the Sr^{87}/Sr^{86} and Rb/Sr ratios, i.e., the tektite groups have age values of approximately 400 m.y. Author

N64-28456 Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center
NAPHTHENIC ACID SOLVENT EXTRACTION OF RARE-EARTH SULFATES
D. J. Bauer and R. E. Lindstrom 1964 23 p refs
(BM-RI-6396)

Studies were conducted to assess the potential of naphthenic acid as a fractional extractant for rare-earth mixtures and yttrium in sulfate solution. Naphthenic acid was an effective extractant, and separation factors were favorable in the presence of aqueous phase chelating agents. Addition of EDTA to the naphthenic acid extraction system resulted in average separation factors of 2.2 between adjacent yttrium-group elements, whereas DTPA resulted in average separation factors of 3.5 between adjacent cerium-group elements. EDTA was of value in separating yttrium from the rare-earth elements. Thorium and uranium were preferentially extracted over the trivalent rare-earth elements by naphthenic acid. Author

N64-28500 Bureau of Mines, Boulder City, Nev. Boulder City Metallurgy Research Lab.
MOLTEN-SALT ELECTROREFINING OF URANIUM
F. R. Cattoi and T. A. Sullivan 1964 29 p refs
(BM-RI-6507)

Commercial uranium metal was electrorefined to a high-purity product by using molten-salt electrolytes in an inert atmosphere cell. Electrorefined uranium that contained, after consolidation, less than 30 ppm of metallic impurities was prepared. A method of leaching the electrolyte crystals to remove the salts was developed. Cathode current efficiencies from 90% to 100% were obtained. Two molten-salt electrolytes were prepared and evaluated: (1) lithium chloride–potassium chloride–uranium trichloride and (2) sodium chloride–potassium chloride–uranium trichloride. Very little difference was found in the purity of the uranium metal produced in either system. The lithium chloride–potassium chloride–uranium trichloride electrolyte was preferable from an operational standpoint. Author

N64-28501 Mound Lab., Miamisburg, Ohio
DEVELOPMENT OF CONDUCTIVE ADHESIVES FLEXIBLE AT LOW TEMPERATURES
L. W. Hartzel and S. S. Sakornbut 10 Aug. 1964 13 p refs
(Contract AT(33)-1-GEN-53)
(MLM-1207)

Conductive adhesives flexible at −65° F were developed with electrical resistivities comparable with commercial, rigid, amine-cured epoxy silver systems. Tentative specifications for the formulations were as follows: electrical resistivity, less than 0.1 ohm-cm; tensile strength, 500 psi minimum; peel strength, 20 lb/in. minimum; and ultimate elongation at −65° F, 10% minimum. Polyurethane, silicone, and polysulfide bases were used with silver and carbon black as conductive fillers. Although no formulation tested satisfactorily met all the requirements, three showed promise. They were a polyurethane formulation filled with carbon black and silver powder; a carbon black-filled silicone with silane primer as a base; and a manganese dioxide-cured polysulfide formulation filled with carbon black and silver powder. The polyurethane formulation has the most satisfactory properties: 0.1 ohm-cm resistivity, 9% elongation, 600 psi tensile strength, and 15 lb/in. peel strength. Author

N64-28513 Weapons Research Establishment (Australia) Dept. of Supply
A SHORT WAVELENGTH REJECTION FILTER TRANSMITTING IN THE 8 TO 14 MICRONS WAVELENGTH RANGE
B. Porter May 1964 11 p refs
(WRE-TN-CPD-87)

The general problem of window materials for the thermal region of the infrared is reviewed briefly. A method for producing an evaporated lead sulphide filter on a dithene plastic substrate is described, and results of some subsequent tests are discussed. Author

N64-28518 Industrial Science and Technology Agency, Tokyo (Japan) Electrotechnical Lab.
STUDIES OF DIELECTRIC PROPERTIES OF ELECTRICAL INSULATING MATERIALS AT VERY LOW FREQUENCIES
Tatsuji Nakajima Jan. 1964 104 p refs *Its* Researches no. 647 in JAPANESE; ENGLISH Summary

This report consists of three parts. In Part I, a measuring apparatus of absorption currents corresponding to dielectric properties at frequencies below 0.1 cps, and a new type of a.c. bridge that is useful for the measurements in the frequency range of 0.1 cps to 10 cps are described. Two measuring cells for solid and liquid dielectrics are illustrated. In Part

II, the relation between absorption currents and dielectric parameters is discussed from a theoretical viewpoint, and the Hamon approximation method, which is the simplest one for deducting the dielectric loss factor from the absorption current, is reexamined as to its restrictions. Before application of the deduction method, the linearity of the dielectric properties of each liquid and solid insulating material is experimentally examined with both d.c. and a.c. methods, and the origins of nonlinearity are discussed. In Part III, the dielectric properties of representative polymers for electrical insulation are examined in the frequency range from 10^{-4} cps to 10^{6} cps and at temperatures from −60° to 150° C. The utility of VLF measurements was proved. I.v.L.

N64-28538 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
THE INFRARED SPECTRA OF PERFLUOROCYCLOPROPANE AND CIS- AND TRANS-PERFLUOROBUTENE-2
Julian Heicklen, Francis Wachi, and Vester Knight 24 Jul. 1964 19 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-144; TDR-269(4240-20)-5; AD-604051)

The infrared spectra in the NaCl region of three simple fluorocarbons—cC_3F_6, cis-C_4F_8-2, and trans-C_4F_8-2—are reported. For the cis and trans compounds, it was necessary to perform the purification procedure twice for complete separation. The spectra were obtained on a Perkin–Elmer 21 infrared spectrometer and are shown. The bands and their relative intensities are listed. Author

N64-28566 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
INVESTIGATION OF CHEMICAL KINETICS OF ATMOSPHERIC DEIONIZATION Final Report
M. H. Bortner and V. D. Povard Mar. 1964 68 p refs
(Contracts AF 19(604)-8820; DASA-WEB-07.010)
(AFCRL-64-496; AD-603509)

The chemical kinetics that control the decay of electron density following a nuclear burst are discussed, and values are suggested for the rate constants of all reactions of importance in the overall process. An analysis of the chemical kinetics of the normal atmosphere at 100 km is given, and those of various nitrogen-containing species at 70 km are analyzed showing the probable importance of N_2O. The results to date on the program for the determination of the rate constant of the dissociative recombination of NO^+ are given. The results of the theoretical calculation of the rate constants of the $O^+ + O^-$ and $N^+ + O^-$ ion-ion recombination reactions are reviewed. Author

N64-28576 Massachusetts Inst. of Tech., Cambridge
STUDY OF THE PHOTOCATALYZED DECOMPOSITION OF WATER AND OF THE MECHANISMS OF INTRAMOLECULAR ELECTRON TRANSFER IN ORGANIC COMPOUNDS Final Report
Lawrence J. Heidt 14 May 1964 158 p refs
(Contract AF 19(604)-5712)
(AFCRL-64-431; AD-603728)

Gross ϕ_g and net ϕ_n quantum yield measurements were made for the photochemical conversion by light of 2537 A of up to 1.4% of the ferrous to ferric sulfate and of the accompanying production of gaseous hydrogen in aqueous sulfuric acid at 25°. In each solution, ϕ_g decreased as the reaction progressed, but ϕ_n remained constant. In the different solutions, ϕ_n remained at 0.4 between 0.1 and 0.8 *M* ferrous sulfate in 2 *M* H_2SO_4, but increased from 0.16 to 0.74 between 0.15 and 6.0 *M* sulfuric acid. The data support the hypothesis that in 2 *M* and more dilute sulfuric acid, ferrous sulfate exists mostly as ion pairs, which in 6.0 *M* sulfuric acid are partly replaced by contact ferrous sulfate complexes Author

N64-28597 Pennsylvania U., Philadelphia Electrochemistry Lab.
REVERSIBLE OXYGEN ELECTRODES Ninth Quarterly Report, 1 Jan.–31 Mar. 1964
A. Damjanovic, V. Brusic, and M. Genshav [1964] 19 p refs
(Contract DA-36-039-SC-88921)
(Rept.-9; AD-603411)

The dependence of the rest potentials established on oxide-free platinum electrodes on pH of the solution was examined at a given partial pressure of oxygen, and the change in the nature of the potential with the time of contact of the electrode with the oxygen saturated solution was analyzed. Catalytic activity for the reduction of oxygen on a number of metal electrodes was examined with the aim of determining what factors or properties of the substrate control the rate of the reaction. The results of oxygen reduction Tafel line on some noble metals and alloys in oxygen-saturated perchloric acid solution are given. The mechanism of oxygen reduction is briefly discussed, in particular with reference to a method of detecting possible intermediates in the reaction. Author

N64-28599 Western Reserve U., Cleveland, Ohio Electrochemistry Research Lab.
THE EFFECTS OF ANIONS AND CATIONS ON OXYGEN REDUCTION AND EVOLUTION REACTIONS ON PLATINUM ELECTRODES
Akiya Kozawa 1 Mar. 1964 46 p refs
(Contract Nonr-2391(00))
(TR-18; AD-603221)

The effects of 10^{-4} to 10^{-1} M of various anions and cations added to 1 N H_2SO_4 and 1 M NaOH solutions on oxygen reduction at preanodized and precathodized platinum electrodes were examined by measuring the coulombic efficiency for the formation of hydrogen peroxide (calculated on the basis of $O_2 + H_2O + 2e^- \rightarrow OOH^- + OH^-$). Current-potential curves were also obtained. In 1 M NaOH, oxygen was reduced to hydrogen peroxide with a coulombic efficiency of almost 100% at the preanodized electrode. In the presence of Ba^{++}, Sr^{++}, and Ca^{++} in 1 M NaOH, however, the efficiency decreased to 10% to 15% with increasing concentration of these ions. In 1 N H_2SO_4, oxygen was reduced principally to water, and the coulombic efficiency for hydrogen peroxide formation was only 10% to 20%. In the presence of Cl^- and Br^- ions this efficiency increased to 50% to 60%. Current-potential curves indicated that overpotential of the oxygen reduction at the platinum electrodes increased in the presence of Ba^{++}, Sr^{++}, and Ca^{++} ions in 1 M NaOH and Cl^- and Br^- ions in 1 N H_2SO_4. Author

N64-28600 Air Products and Chemicals, Inc., Allentown, Pa.
ARGON-OXYGEN-NITROGEN THREE COMPONENT SYSTEM EXPERIMENTAL VAPOR LIQUID EQUILIBRIUM DATA Technical Documentary Report, Jul. 15, 1962–Apr. 8, 1964
G. M. Wilson, P. M. Silverberg, and M. G. Zellner Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Apr. 1964 343 p refs
(Contract AF 33(657)-8742)
(APL-TDR-64-64; AD-603151)

This report presents the results for the experimental determination of vapor–liquid equilibrium data in argon, oxygen, and nitrogen mixtures. The experimental apparatus and procedures are described. The experimental data at 26, 23, 20, 18, 16, 14, 12, 10, 8, 6, 4, 2 and 1 atm levels are presented, and a correlation of experimental data is made. Plots and tables

of equilibrium constants, relative volatilities, and activity coefficients are presented. Experimental and calculated results are compared, and a comparison of the data to the literature is made. Analytical enthalpy data is presented. The correlation reproduces the experimental data with an error less than 2.5%, being worst at 20 atm and best at 6 atm. Author

N64-28609 University Coll. of Wales, Aberystwyth (Gt. Brit.)
MOLECULAR PARAMETERS AND BOND STRUCTURE, PART 3: CARBON-OXYGEN BONDS Scientific Report No. 9
J. A. Ladd, W. J. Orville-Thomas, and B. C. Cox 8 May 1964 22 p refs
(Contract AF 61(052)-691)
(AFCRL-64-508; AD-603040)

Using accurately known bond stretching force constants, f, and bond lengths, r, a relation of the form $f = 35.5/r^{5.79}$ millidynes/A was obtained for carbon-oxygen bonds. This relation was used together with the possible sets of force constants to obtain unique values for all force constants occurring in the quadratic potential function for the carbonate ion. Author

N64-28632 Joint Publications Research Service, Washington, D.C.
ROENTGENOGRAPHIC INVESTIGATION OF THE RECRYSTALLIZATION PROCESSES OF THE BORIDES OF TITANIUM, ZIRCONIUM AND MOLYBDENUM, AND THE CARBIDES OF TITANIUM AND TUNGSTEN
C. C. Gorelik, V. P. Yelyutin, Ye. I. Mozzhukhin, U. S. Urazalien, and V. F. Fynke 6 Nov. 1962 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvet. Met. (Dzaudzhikau), No. 4, 1962 p 143-148
(JPRS-16059) OTS: $1.60

The present paper deals with X-ray research of the process of recrystallization of the borides of TiB_2, MoB, the carbides TiC and WC, as well as metallic molybdenum. The method used was that of the surface bonding of samples, polishing them by abrasion, and then determining, by means of X-rays, the structural changes in the bonded layer as it is being heated. The boride of molybdenum was obtained by the carbon method, whereas the borides of titanium and zirconium were produced by the boro-carbidic method. Author

N64-28633 Joint Publications Research Service, Washington, D.C.
DUCTILE NIOBIUM PRODUCTION FROM ELECTROLYTIC POWDERS
V. M. Amosov 6 Nov. 1962 23 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Tsvet. Met. (Dzaudzhikau), no. 4, 1962 p 122-131
(JPRS-16063) OTS: $2.60

Several questions dealing with the production of niobium from electrolytic powders are discussed. Special attention was paid to an examination of the high-temperature processes for refining niobium in a vacuum. Author

N64-28653* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INHIBITION OF THIOL-ACTIVATED AMINOPEPTIDASE BY PUROMYCIN
Stanley Ellis and Manuel Perry Repr. from Biochem. and Biophys. Res. Commun., v. 15, no. 6, 1964 p 502-505 refs
(NASA-RP-252)

Pituitary extracts have been shown to contain a thiol-activated aminopeptidase(s) that preferentially hydrolyzes dibasic amino acyl derivatives of p-nitroaniline and β-naphthylamine. Investigations are described that show that the thiol-activated aminopeptidase was strongly inhibited by puromycin. Leucine aminopeptidase, on the other hand, was not affected by puromycin either in the hydrolysis of p-nitroanilides of dipeptides. These results provide a basis for distinguishing the action of the thiol-activated aminopeptidase on p-nitroanilide substrates from that of leucine aminopeptidase, in addition to the known differential effects of -SH on these two enzymes. The properties of the thiol-activated aminopeptidases, when considered in relation to the inhibition by puromycin, are suggestive of involvement in the amino acyl s-RNA metabolism. I.v.L.

N64-28658 India. Dept. of Atomic Energy, Bombay Atomic Energy Establishment Trombay
GRAIN BOUNDARY AND LATTICE DIFFUSION OF CHROMIUM IN ZIRCONIUM
R. P. Agarwala, S. P. Murarka, and M. S. Anand 1964 20 p refs
(AEET/CD/22)

Diffusion of chromium in grain boundaries and in alpha and beta phases of zirconium were studied using radioactive tracer and residual activity technique. The diffusivities (in units of cm^2/sec) were expressed as $DCr/Zr\ (gb) = 1.498 \times 10^{-5} \exp(-11.950/RT)$, $DCr/Zr(\alpha) = 1.193 \times 10^{-8} \exp(-18,000/RT)$, and $DCr/Zr\ (\beta) = 3.850 \times 10^{-2} \exp(-41,000/RT)$. Results were compared with other diffusion studies in zirconium, and stronger bonding between chromium and zirconium in solid solution of zirconium is suggested. Author

N64-28664 Western Reserve U., Cleveland, Ohio
INORGANIC MACROMOLECULES CONTAINING A SILICON-OXYGEN-METAL LINKAGE Final Report
Mark M. Chamberlain 1 Jun. 1964 10 p refs
(Contract Nonr-1439(07))
(AD-601415)

Compounds were prepared containing the linkage Si-O-M where M is vanadium, niobium and tantalum, chromium and tungsten, and phosphorus and tin. In addition, and as a direct outgrowth of attempts to stabilize the linkage by coordinatively saturating the metal, two new, true tetramolybdates were characterized, and the coordinating tendencies of the blocking ligand P,P-diphenylphosphino acetic acid were determined. An inexpensive, highly reproducible, differential thermal analysis device was designed and, coupled with the technique of dynamic gas evolution, used to determine the decomposition patterns of a series of cyano and nitrosylcyano transition metal complexes. This device was used extensively in characterizing other compounds produced during the study. Author

N64-28665 University Coll., London (Gt. Brit.)
FOUR COORDINATE COMPLEXES OF CARBON
R. N. Collings, R. S. Nyholm, and M. L. Tobe Mar. 1964 4 p Submitted for Publication
(Contract N 62558-3589)
(TR-1; AD-441241)

Studies of the complexes formed by the $1s^2$ core (light) elements, beryllium and boron, with the ditertiary arsine, o-phenylene bis(dimethylarsine) were extended to carbon. Dihydro[o-phenylene bis(dimethylarsine)] carbon IV salts (bromide, iodide, and perchlorate) and dihydro[o-phenylene bis-(dimethylarsine)] carbon IV salts (bromide, iodide, and perchlorate) were prepared. These complexes are stable white crystalline solids that are extremely soluble in water. The bromide and iodide ions are readily titratable. The unique feature of these new complexes is the number of quaternary arsenic atoms (or coordinate links) associated with the same carbon atom. I.v.L.

N64-28669 Army Materials Research Agency, Watertown, Mass. Materials Research Div.
THE DISSOCIATION ENERGIES OF DIATOMIC MOLECULES OF THE TRANSITION ELEMENTS. PART I—NICKEL
Arthur Kant Jun. 1964 14 p refs
(AMRA-TR-64-11; AD-602069)

The Ni_2 molecule was shown to exist in the vapor phase over liquid nickel above 2,000° K. Using information derived from a combination of effusion and mass spectrometric techniques, the dissociation energy of Ni_2 was calculated from the ratio of dimeric and monomeric nickel in equilibrium with liquid: D°_0 (Ni) = 54.5 ±5 kcal. From the accepted value of the heat of sublimation of nickel and the dissociation energy of the dimer, the heat of sublimation for the process 2 Ni(solid) = Ni_2(gas) is, at 0° K, 146.9 ±7 kcal. Author

N64-28671 Parametrics, Inc., Waltham, Mass.
DEVELOPMENT OF KRYPTON-85 AS A UNIVERSAL TRACER. CONTINUATION OF PHASE III. AREAS OF APPLICATION Report Covering the Contract Period, 1 Nov. 1962–31 Oct. 1963
David Chieck, Richard Maehl, and Orlando Cucchiara 1 Nov. 1963 100 p refs
(Contract AT(30-1)-2757)
(NYO-2757-3) OTS: $2.25

The purpose of this project is the development of techniques for the utilization of Kr^{85}, beta-emitter, as a universal tracer atom. Research conducted was divided into four areas. The first was an extension of the methods of preparing "kryptonates" using a high-temperature, high-pressure diffusion process. The objective was to determine better means of producing higher specific-activity sources. The second area was concerned with the evaluation of the prepared "kryptonates" as agents that could be used in the direct chemical analysis of various chemical species in solution. Most of the effort was concerned with the utilization of "kryptonates" as true mass-sensing chemical reagents. The third area was concerned with a feasibility study of the indirect analysis of chemical species in solution. "Kryptonates" were utilized as titration end-point indicators through the release of Kr^{85} at the chemical end-point. The determination of the aqueous fluoride ion was chosen for investigation because of the need for a reliable automatic method for this particular analysis. The fourth area of investigation was the initiation of a program for the evaluation of the usefulness of "kryptonates" in the study of friction and wear parameters. I.v.L.

N64-28681* National Bureau of Standards, Washington, D.C.
PYROLYSIS OF POLYTRIFLUOROETHYLENE: INFLUENCE OF GAMMA RADIATION AND ALKALI TREATMENT
S. Straus and L. A. Wall Repr. from SPE Trans., v. 4, no. 1, Jan. 1964 p 1–5 refs
(NASA Order R-56)

The mechanism of thermal decomposition of polymers of trifluoroethylene given a prior alkali treatment can be altered from one that leaves no residue to one that produces an appreciable quantity of extremely stable residue. The residue contains a high percentage of the original fluorine, and hence is not as highly conducting as graphitic carbon, which is the residue in the decomposition of some polymers, e.g., polyvinyl chloride. The production of a residue with the simultaneous formation of gaseous hydrogen fluoride is also potentially useful where thermal protection is needed. It was also found that prior gamma irradiation of the polymer greatly enhances its rate of volatilization on pyrolysis. Since these products appear to be the result of random degradation, the combination of gamma radiation and pyrolysis, either separately or simultaneously, might well be a useful process for the production of low-molecular-weight oils and greases from this polymer. Author

N64-28694 International Union of Pure and Applied Chemistry, Basle (Switzerland) Commission on High Temperatures and Refractories
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS, NO. 12
L. Brewer, comp. (Calif. U., Berkeley) 30 Jun. 1964 26 p refs

N64-28700 Brookhaven National Lab., Upton, N.Y.
CHEMISTRY OF ISOTOPES
Jacob Bigeleisen 16 Oct. 1963 20 p refs *Its* Lecture Ser. No. 30
(Sponsored by AEC)
(BNL-870(T-349)) OTS: $0.50

A brief survey is presented of the principles of isotope chemistry (with the exception of chemical kinetics) and of their applications to the study of intermolecular forces, geochemistry, and life sciences. M.P.G.

N64-28701 Florida U., Gainesville College of Engineering
FLUOROCARBON N-F COMPOUNDS Quarterly Technical Report
R. D. Dresdner, S. Merritt, J. S. Johar, and J. P. Royal 1 Apr. 1964 10 p ref
(Contract DA-01-009-ORD-772; ARPA Order 40-59)
(QTR-19; AD-443885)

Crude rate studies have been carried out on the UV-irradiated vapor phase reaction between C_2N_2 and N_2F_4 under two sets of initial composition—N_2F_4/C_2F_2 mole ratios of 2:1 and 1:1, respectively. Chain retention is superior in the latter case, and a sufficient amount of pure NF_2CF_2CN was obtained for a positive identification and some physical property data—BP 32° C; mol. wt. 129; heat of vaporization 5,630 calories per mole; Trouton's constant 23.4; and an NMR spectrum. A UV-irradiated reaction with $(PNF_2)_3$ and N_2F_4 was attempted. The main products were thermal and water sensitive solids other than $(PNF_2)_x$ type polymers. $CF_3N{=}SF_2$ was reacted with excess CoF_3 at 200° C and 1,960 psi, and a small amount of product boiling at about 30° C was obtained. Author

N64-28705* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VAPOR PRESSURE AND VAPOR FRACTIONATION OF SILICATE MELTS OF TEKTITE COMPOSITION
L. S. Walter and M. K. Carron (Geol. Survey) Repr. from Geochim. Cosmochim. Acta, v. 28, 1964 p 937–951 refs
(NASA-RP-298)

The total vapor pressure of Philippine tektite melts of approximately 70% silica was determined at temperatures ranging from 1,500° to 2,100° C. This pressure is 190 ±40 mm Hg at 1,500° C, 450 ±50 mm at 1,800° C, and 850 ±70 mm at 2,100±C. Determinations were made by visually observing the temperature at which bubbles began to form at a constant low ambient pressure. By varying the ambient pressure, a boiling point curve was constructed. This curve differs from the equilibrium vapor pressure curve due to surface tension effects. This difference was evaluated by determining the equilibrium bubble size in the melt and calculating the pressure due to surface tension, assuming the latter to be 380 dyn/cm. Author

N64-28753* Alabama U. Research Inst., Huntsville
NORMAL AND OBLIQUE SHOCK WAVE PARAMETERS FOR VARIOUS DISSOCIATED UPSTREAM CONDITIONS IN AIR WITH FROZEN COMPOSITION ACROSS THE SHOCK
Janardanarao Yalamanchili and Jurgen Thoenes Jul. 1964 259 p refs
(Grant NsG-381)
(NASA-CR-58490; UARI-RR-4) OTS: $16.50 ph

Shock transition conditions are presented that are applicable to normal and oblique shocks in air within the range of oxygen dissociation. It is assumed that the chemical composition of the air is frozen across the shock. The molecular vibrations are assumed to be in equilibrium. Results are given for free-stream velocities from U_1 = 800 to 6,000 m/sec, free-stream static temperatures from T_1 = 100 to 1,000° K, and for selected values of free-stream oxygen dissociation. Author

N64-28774 Chicago U., Ill.
PHOTOIONIZATION STUDIES USING A MASS SPECTROMETER Final Report
Mark G. Inghram Jan. 1964 183 p refs
(Contract AF 19(604)-8011)
(AFCRL-64-106; AD-444546)

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N64-28782 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
SEPARATION OF TRIVALENT RARE EARTHS FROM CERIUM
L. A. Bray and F. P. Roberts Oct. 1963 13 p refs
(Contract AT(45-1)-1350)
(HW-78987, Rev.) OTS: $0.50

A process is described for the separation of fission product cerium from promethium and other trivalent rare earths. The method includes the coextraction of the rare earths and Ce(III) into di(2-ethylhexyl)phosphoric acid (D2EHPA) diluted with tri-n-butyl phosphate (TBP) and kerosene from an aqueous feed solution containing a complexing agent in the proper pH range. The extract is then contacted with an aqueous solution containing potassium persulfate oxidant, silver catalyst, and nitric acid. Under these conditions, cerium is oxidized to Ce(IV) and remains in the organic phase while promethium and the other trivalent rare earths are stripped into the aqueous phase. Optimum concentrations of the reagents are indicated. Following phase separation, pure Ce(IV) is reduced and removed from the organic phase as a highly purified product. The promethium product is free from isotopes that generate penetrating radiations and large amounts of heat. M.P.G.

N64-28802 Joint Publications Research Service, Washington, D.C.
THE USE OF THE ELECTRON PARAMAGNETIC RESONANCE METHOD IN BIOCHEMISTRY
A. C. Kalmanson 21 Aug. 1964 106 p refs Transl. into ENGLISH from Usp. Biol. Khim. (Moscow), v. 5, 1963 p 289–304
(JPRS-26059; TT-64-41329) OTS: $4.00

This report constitutes a survey of results on the use of electron paramagnetic resonance (EPR) obtained through biological studies. The following areas are covered: (1) the nature of EPR spectra and their analysis; (2) characteristics of the use of EPR in biology; (3) the EPR spectra of free radicals that occur in biological oxidation processes; and (4) the EPR spectra of free radicals that occur in biological substances, such as proteins, amino acids, etc., upon the action of ionizing radiation. I.v.L.

N64-28805 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
THE ISOMERISM OF DINITROGENTETROXIDE: THE KINETICS OF THE REACTION OF NITROGEN DIOXIDE WITH HYDRAZOIC ACID IN THE GAS PHASE [ZUR FRAGE DER ISOMERIE DES DISTICKSTOFFTETROXIDES: KINETIK DER UMSETZUNG VON STICKSTOFEDIOXID MIT STICKSTOFFWASSERSTOFFSAURE IN DER GAS PHASE]
F. Seel, W. Birnkraut, and E. Lange Nov. 1962 8 p ref Transl. into ENGLISH from Chem. Ber. (W. Germany), v. 94, no. 6, 1961 p 1436–1442
(TIL/T-5369)

The kinetics of the reaction of nitrogen dioxide with gaseous hydrazoic acid in the temperature range from 20° to 50° C was spectrophotometrically investigated. The reaction takes place in the second order with reference to NO_2 and in the first order with reference to N_3H. The *negative* temperature coefficient of its speed points to a preliminary exothermal equilibrium. For the reaction of normal N_2O_4 with hydrazoic acid, the activation energy of 3.2 kcal/mol can be calculated with the aid of the dissociation constant of dinitrogentetroxide. The stoichiometry of the reaction and the anomalous Arrhenius factor, however, indicate that nitrogen dioxide does not react through the symmetrical dinitrogentetroxide present in the NO_2/N_2O_4 equilibrium, but through the isomeric molecular form $ONONO_2$ (nitrosyl nitrate). Thermodynamic data with regard to the equilibrium between the two isomers can be estimated. Author

N64-28818 American Cyanamid Co., Stamford, Conn. Central Research Div.
CHEMILUMINESCENT MATERIALS Technical Report, Mar. 1–May 31, 1964
M. M. Rauhut et al [1964] 79 p refs
(Contract Nonr-4200(00); ARPA Order 299, Amend. 3)
(TR-4; AD-602272)

Progress in determining the processes fundamental to chemiluminescence is described with particular reference to the following: mechanism studies of oxalyl peroxide, 3-aminophthalhydrazide, and anthracene photoperoxide chemiluminescent reactions; and energy-transfer studies in chemiluminescent systems. I.v.L.

N64-28867 Bausch and Lomb, Inc., Rochester, N.Y.
STUDY OF NON-OXIDE MATERIALS WITH DEFECT STRUCTURES Semi-Annual Technical Report, Period Ending 30 Apr. 1964
D. A. Buckner and N. J. Kreidl 1964 9 p ref
(Contract Nonr-3632(00); ARPA Order-269)
(AD-602150)

The preparation of new fluorides expected to possess controllable gross defects and the determination of their physical properties, especially as a function of the amount and nature of the defect, are discussed. The following systems were studied in detail: CaF_2-YF_3, CaF_2-$NaYF_4$, CaF_2-$NaLaF_4$, MgF_2-NiF_2, and KF-MgF_2-NiF_2. Large-batch preparations have been attempted in order to provide the starting material for large polycrystalline specimen preparation and for characterization of the accomplished defects. A suitable reaction furnace has been developed for large-batch preparation. A hotpress is in operation and enables small-test hotpressing to establish the parameters for preparing the large specimens. P.V.E.

N64-28888* Stanford U., Calif.
COMPUTATION OF MOLECULAR FORMULAS FOR MASS SPECTROMETRY
Joshua Lederberg San Francisco, Holden-Day, 1964 77 p refs
(Grants NsG-81-60; NSF G-6411; NIH G-NB-04270-01; NIH G-NB-04270-02; NIH G-AI-5160-06)
(NASA-CR-58597) OTS: $7.60 ph

The computation of molecular formulas by mass spectroscopy is examined. A reduced tabulation of mass values is presented, and its use in formula determination is illustrated. In the course of developing a computer program for the analysis of mass spectra, the problem arose as how to generate, systematically, the formulas consistent with a given integer mass. An algorithm was developed that also facilitates rapid reckoning in the laboratory. It is based on the concept that an organic formula can be dissected into the following parts: H termination, alkane skeleton, degrees of saturation, amino, and oxygen. In addition, the contribution to the satellite intensity, at m + 1 relative to m, by C^{13}, H^2, and N^{15} is presented in tabular form. I.v.L.

N64-28905 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
ELECTRON-SPIN MAGNETIC RESONANCE OF FREE-RADICAL INTERMEDIATES IN GAMMA-IRRADIATED HYDROCARBONS
J. A. Staples, III 12 Apr. 1963 93 p refs
(Contract AF 33(657)-7201)
(NARF-63-4T; MR-N-299; AD-417705)

Results of a study of the character and origin of the electron-spin magnetic-resonance spectra of gamma-irradiated hydrocarbon compounds are presented. The compounds examined include selected alkanes, alkenes, alkynes, branched alkanes, and cycloparaffins. All irradiations and resonance measurements were performed at 77° K. Spectral analysis was directed toward identification of the chemical species responsible for the observed hyperfine patterns. Structural interpretation was confined to free-radical species resulting from carbon–hydrogen and carbon–carbon bond scission in the parent molecule. These results are incorporated into an evaluation of the current status of free-radical spectra from irradiated hydrocarbons. Author

N64-28954* University of Southern Calif., Los Angeles
EQUATION OF STATE AND RELATED PROPERTIES OF POLYMER AND OLIGOMER LIQUIDS
V. S. Nanda and Robert Simha [1964] 26 p refs Submitted for Publication
(Grant NsG-343)
(NASA-CR-56914) OTS: $2.60 ph

In the cell theory of chain liquids, the consequences of approximating the cell potential by a square well are discussed. The theoretical equation of state is in satisfactory agreement with the experimental volume–temperature data over a wider range of reduced volume, viz. $1 \leq \tilde{V} \leq 1.2$, than was found previously. The numerical values of the energy, flexibility, and volume parameters for all the polymer series discussed earlier are now modified. The variation of cohesive energy density with temperature and molecular weight is well described by the theory. This permits the calculation of the cohesive energy density for high polymers without recourse to swelling data. In respect to the internal pressures, however, no such agreement was found. Nevertheless, it is possible to establish the validity of the principle of corresponding states for properties such as internal pressure and compressibility at low external pressures. Author

N64-28968* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
POLYMER DEGRADATION III. CARBON-14 AS A TRACER FOR STUDIES OF THE THERMAL DEGRADATION OF POLYURETHANS
R. Simha, J. D. Ingham, N. S. Rapp, and J. Hardy Repr. from Polymer Letters, v. 2, 1964 p 675–679 refs
(Contract NAS7-100; ARPA Order 107-62)
(NASA-CR-58348; JPL-TR-32-603)

Experiments with polymers prepared from carbon-14-labeled diisocyanates were performed to examine the utility of tracer applications for degradative studies and to determine further details of the degradative process for polyoxypropylene glycol-toluene diisocyanate polymer (PPG-TDI). Preliminary results only are reported. A.W.

N64-28982 Princeton U., N.J. Frick Chemical Lab.
CLEAVAGE REACTIONS IN CROSSLINKED URETHANE ELASTOMERS
A. N. Tobolsky, J. Johnson, and W. J. Mac Knight Jun. 1964 17 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-82; AD-601851)

A study of network cleavage in a cross-linked polyurethane elastomer was made using the technique of stress relaxation. It was found that the data could be well represented by a sum of two exponential decay terms, and a theoretical explanation for this is presented. Stress relaxation in the polyurethane sample investigated is discussed in terms of the reversible cleavage of various linkages formed by isocyanate reactions. It is possible to identify two different decay processes and obtain activation energies for these processes. These are identified with cleavage of two different linkages. It is not possible at present to give a certain chemical identification of the linkages responsible for stress decay. Author

N64-29011 Ohio State U. Research Foundation, Columbus
ELECTRON IMPACT STUDIES OF MOLECULAR GASES Final Report

Edwin N. Lassettre Jul. 1964 97 p refs
(Contract AF 19(604)-4541)
(AFCRL-64-669; AD-445853)

Results obtained in the study of oscillator strengths by electron impact methods are briefly summarized, and references are given to pertinent reports and papers. Attention is particularly directed to reports describing the performance of a newly developed electron source that provides velocity selection on the electron beam before scattering. A bibliography of publications is included together with a group of reprints that describe the development of both the theory and the experimental technique. Author

N64-29012 American Oil Co., Whiting, Ind. Research and Development Dept.
BASIC STUDY OF SORPTION OF ORGANIC FUELS DURING OXIDATION AT ELECTRODES Eleventh Quarterly Report, Apr. 1–Jun. 30, 1964
Robert J. Flannery, Gerald Aronowitz, Ahmad Sam, Donald C. Walker Jul. 1964 33 p refs
(Contract DA-11-022-ORD-4023; ARPA Order 247-62; Amend. 4)
(AROD-3472-3; M64-204; AD-444431)

The objective of this program is an improved understanding of the role of sorption processes at electrodes in the electrochemical oxidation of carbonaceous fuels. Studies of the sorption of radio-n-butane on a thin-film platinum electrode in 1 N H_2SO_4 at 25° C and at potentials in the range of 0 to 1.5 v (NHE) were continued. Maximum adsorption occurs at about +0.4 v (NHE), near the zero charge potential. At lower concentration of butane, coverage decreases and the potential of maximum adsorption shifts to more negative values. Fractional coverage was not determined but was estimated to be of the order of tenths. Use of tantalum underlayment to improve the adhesion of platinum film electrodes to mica has given promising preliminary results. Capacitance work directed toward the temperature dependence of methanol adsorption continued, with emphasis on the state of the electrode surface resulting from electrode pretreatment and potential programing. Author

N64-29013 General Electric Co., Philadelphia, Pa. Missile and Space Div.
EFFECTS OF CONTAMINANTS ON OBSERVABLES IN REENTRY First Quarterly Technical Report
Walter E. Kaskan [1964] 27 p refs
(Contract DA-31-124-ARO-D-214; ARPA Order 553)
(AROD-5137-1; AD-445318)

An analytic program is underway that is designed to delineate the important processes involving both ionization of and radiation from sodium under reentry conditions. Initial emphasis is being given to the problem of radiation from various excited states, including the effects of cascading from higher states formed by electron–ion recombination, and of collisional excitation and deexcitation. Also, a discussion of the present knowledge of the chemistry of H_2–CO–air flames is given, and of the chemistry of sodium in such flames, including the effects of the known nonequilibrium conditions that may prevail. The existing experimental apparatus is described, and the progress in developing a satisfactory method of seeding low pressure flames with sodium is discussed. Author

N64-29016 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CATALYTIC ACTIVITY OF ORGANIC POLYMERS
N. P. Keyer, G. K. Boreskov et al 21 Jun. 1963 19 p refs Transl. into ENGLISH from Kinetika i Kataliz (USSR), v. 3, no. 5, 1962 p 680–690
(FTD-TT-63-414/1+2; AD-414801)

The laws governing catalytic activity of polychelates of various metals, in which the polymeric addenda differed in composition, were investigated. It was discovered that catalytic activity is determined by the chelated metal itself, by the nature of the atoms linked to the metal, and by the nature of the organic radicals in the polymer. Monomeric analogs of a number of polymers are catalytically inactive. No relationship was discovered between catalytic activity and electric conductivity. D.E.W.

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-27872* Pennsylvania State U., University Park Ionosphere Research Lab.
SECOND-ORDER EFFECTS IN HIGH-FREQUENCY TRANSIONOSPHERIC PROPAGATION Scientific Report No. 216
W. J. Ross 10 Aug. 1964 49 p refs
(Grant NsG-114-61)
(NASA-CR-58201) OTS: $4.60 ph

Refraction and polarization rotation effects in high-frequency radio waves passing through the ionosphere are commonly used to determine the integrated electron content by applying a first-order ray theory. More detailed analyses show that the distribution of ionization enters the theory in second-order effects. Previously, these second-order effects were included in the analyses by solving for the propagation paths in model ionospheres using digital computers and adjusting the model to fit the observations. This paper presents an analytical derivation of the second-order effects, in a form suitable for manual data reduction, and includes the effects of nonlinear refractive index, ray path bending, and magnetoionic mode splitting. Application of the equations to ionospheric models shows order-of-magnitude error reduction as compared to first-order analysis methods. The significance of the results in experiments involving phase path dispersion and polarization rotation dispersion is discussed. It is proposed that maps of certain parameters of the second-order equations be computed in conjunction with the magnetic field component maps required by the first-order equations, so that manual inclusion of second-order effects may be possible in the analysis of data from beacon satellites. Author

N64-27882* Northeastern U., Boston, Mass.
CERTAIN THEORETICAL ANTENNA PROBLEMS FOR RADIO ASTRONOMY Status Report, Jul. 1, 1964
Sheldon S. Sandler [1964] 2 p ref
(Grant NsG-355)
(NASA-CR-56937) OTS: $1.10 ph

A theory that gives the driving point impedance and current of a traveling wave V-antenna is summarized. The theory also predicts the optimum value of load resistance for the antenna. The complete far-field pattern for the V-antenna was programed, and the results are compared with experimental results obtained by Izuka. R.T.K.

N64-28018 Joint Publications Research Service, Washington, D.C.
ELEMENTS OF DISCRETE SYSTEMS OF COMMUNICATION
V. I. Shlyapoberskiy 31 Jul. 1964 243 p refs Transl. into ENGLISH of the book "Elementy Diskretnykh Sistem Svyazi" Moscow, 1962 p 3–233
(JPRS-25674; TT-64-31946) OTS: $6.00

This book gives the basic concepts and definitions of discrete (code) communications systems (DCC) and sets forth the problems of coding and the methods of sending and receiving encoded information. It examines in detail the components of the equipment, the design principles, and the circuits of the basic units of DCC with noncontact components. It throws light on the problems of synchronization and phasing, the methods of recording the pulses received, and the margin of error. The terminal equipment is described. Author

N64-28067 Aerospace Industries Assn. of America, Inc., Washington, D.C. Aerospace Research and Testing Comm.
INTEGRATED TELEMETRY STANDARDS
Natl. Std. Assn., Inc., Jun. 1964 92 p
(ARTC-40) Available from Natl. Std. Assn., Inc., 1321 14th St., Washington: $1.50

Integrated telemetry standards are presented for multiplexing systems, reference signal generators, transmitters, receivers, and magnetic tape recorder–reproducers. G.D.B.

N64-28088* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXAMPLES OF CERTAIN DATA REDUCTION AND MAPPING PROCEDURES UTILIZING TIROS III FIVE-CHANNEL RADIOMETER DATA
Lewis J. Allison and Guenter Warnecke 30 Apr. 1964 40 p refs
(NASA-TM-X-55047; X-651-64-132) OTS: $3.60 ph

This paper briefly reviews the satellite radiation experiment and discusses the current TIROS radiation data reduction processes. This improvement and modification of the computer processing procedures make it possible to reduce the location (closed mode) uncertainties of the data and to accept low but real measurements so that these data can be used in operational weather analyses. Author

N64-28135 Weapons Research Establishment (Australia) Dept. of Supply
THE MEQES LAYER: ITS OCCURRENCE AND OBLIQUE TRANSMISSION PROPERTIES WITH SPECIAL REFERENCE TO SOUTHEAST ASIA
R. F. Treharne Apr. 1964 39 p refs
(WRE-TN-CPD(T)-108)

The MEQES layer occurs daily in a belt along the magnetic equator, which is centered some 1,000 km to the north of the geographic equator in Southeast Asia. Oblique radio wave transmission via this layer from either above or below it is complicated by the very limited width of the belt, by its unusual scattering properties, and by its aspect sensitivity. These matters are discussed briefly in terms of a simple theory of correlated anisotropic irregularities and the few experimental results that are available. Author

N64-28146 Lincoln Lab., Mass. Inst. of Tech., Lexington
METHODS FOR THE ADAPTIVE OPTIMIZATION OF BINARY DETECTION SYSTEMS
Harold J. Kushner 9 Nov. 1962 59 p refs
(Contract AF 19(628)-500)
(Rept.-226-2; AD-290741)

Adaptive techniques are considered for the experimental optimization of binary detectors that operate in a partially unknown environment. The purpose of the detectors is to determine whether a fixed signal is present. Considered are unknown discrete signal and known noise correlation; unknown noise correlation and known discrete signal; the continuous versions of the first two considerations; and a signal optimization problem with unknown noise correlation. Two approaches are taken. The first involves the use of estimates of the unknown quantities obtained by averaging operations at the filter input. For the second approach, simple constraints are used on the filter parameter vector t that make the output a random variable whose expected value is the signal-to-noise ratio (S/N). The S/N is then maximized by a first-order iterative process on t. The iterative process is known in the mathematical statistics literature as stochastic approximation. Author

N64-28147 Ohio State U. Research Foundation, Columbus Antenna Lab.
SCATTERING BY AN ARBITRARY ARRAY OF PARALLEL WIRES
Jack H. Richmond 30 Apr. 1964 31 p refs
(Contract N-123(953)-31663A)
(Rept.-1522-7; AD-443833)

Equations are developed for the scattering pattern of an arbitrary array of parallel wires. The wires are assumed to be infinitely long, perfectly conducting, and very small in diameter in comparison with the wavelength. The incident wave is assumed to be TM with respect to the wire axis, but it may have normal or oblique incidence on the wires. The solution includes the interaction effects among all the wires. Computer programs are included along with numerical data for the currents induced in the wires in plane arrays, circular arrays, square arrays, and others. The far-field scattering patterns of these arrays are presented graphically. If a sufficiently great number of wires is present, the scattering pattern approaches that of a solid conducting cylinder of the same cross-section shape as the wire-grid array. In this connection, the theory may be applied to a shipboard situation in which a radiating element or an incoming plane wave illuminates the superstructure and the field distribution is thereby distorted. Author

N64-28162 Aerospace Corp., El Segundo, Calif. Electronics Div.
ANTI-JAM COMMUNICATIONS SYSTEMS
S. L. Levine Apr. 1964 53 p
(Contract AF 04(695)-269)
(SSD-TDR-64-74; TDR-269(4540-80)-1; AD-445897)

Jamming protection for some communications systems is achieved by pseudorandomly spreading the information energy in both frequency and time. Spreading plans are classified as frequency hopping, time hopping, and frequency–time hopping. A model representing each of these schemes as a special case is established. The error rates for these spreading plans are compared for several jamming strategies, and for two methods of coherent detection—correlation detection and majority vote detection. Author

N64-28227 Watkins-Johnson Co., Palo Alto, Calif.
RADIO INTERFERENCE MEASURING SET AN/URM-100 (XE-1) Second Quarterly Progress Report, 26 Sep.–25 Dec. 1963

William E. Budd and Marshall H. Hollimon [1963] 37 p
(Contract DA-36-039-AMC-02328(E))
(Rept.-2; AD-434979)

The preliminary work leading to the design plan for the AN/URM-100(XE-1) is essentially complete. The areas of microwave subsystem, IF subsystem, and data handling have all been extensively examined, and basic block diagrams have been prepared. Development of the stable BWO local oscillator has progressed quite satisfactorily. It has been found unnecessary to use a YIG-stabilizing loop to achieve the desired performance. Sensitivity, linearity, and spurious signal generation measurements were made on both a conventional mixer and a tunnel diode mixer, and the results are given. Odd order product (IM) measurements were made on an ultra-low-noise TWT, and these results are presented. The measured data show excellent agreement with prior predictions. It is shown that mixer fourth-order and TWT third-order products will be the first spurious responses to appear as the input power is increased from low levels. Author

N64-28247 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE, APRIL 1964
[1964] 42 p

Orbital data from optical observations of satellites during April 1964 are tabulated, by satellite, for a large number of satellites. The coordinates of three new observing stations reporting to the Prediction Service are also given. M.P.G.

N64-28270* Thompson Ramo Wooldridge, Inc., Canoga Park, Calif. TRW Computer Div.
RESEARCH ON AN ADVANCED NASA INFORMATION SYSTEM
11 Oct. 1963 153 p refs
(Contract NASw-538)
(NASA-CR-58480) OTS: $11.50 ph

This report discusses research covering five separate, but closely related, studies on an advanced scientific and technical information system. The first study, Advanced NASA Information System, discusses the basic system functions and operations. The purpose of the second study, Quality Identification, is to create a usable definition of the quality of a document from two points of view—its adequacy to satisfy an information need, and its potential for idea stimulation. The third and fourth studies, Fragment Retrieval and Information Correlation are experimental approaches to the problem of assimilation of selected material at the operation level of retrospective general search. The fifth study, System Effectiveness, attacks the problem of how to measure quantitatively the effectiveness of a selection procedure. Author

N64-28447 Joint Publications Research Service, Washington, D.C.
USSR STUDIES ON COMMUNICATIONS SYSTEMS
3 Sep. 1964 26 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 7, 1964
(JPRS-26269; TT-64-41528) OTS: $1.00

Two developments in communications systems in the U.S.S.R are reported. The first is a system of information transmission with address interrogation of code words rejected in the preceding transmissions; the requirements to be met for authenticity of address transmission and volume of the address storing device are discussed. The second concerns methods of designing automatic radiotelephone stations, with frequency division of channels to permit equal accessibility of channels. A block diagram of a self-tuning ultrashortwave radiotelephone in an automatic radiotelephone station is discussed. M.P.G.

N64-28449 Argonne National Lab., Ill.
IPL-VC. A COMPUTER SYSTEM HAVING THE IPL-V INSTRUCTION SET
Donald Hodges May 1964 18 p refs
(Contract W-31-109-ENG-38)
(ANL-6888) OTS: $0.50

Shaw *et al.* have described a possible hardware computer, called IPL-VI, which showed the important features such a machine should have for its IPL-V instructions, but the input–output and arithmetic instructions are not considered. However, with the arrival of the present-day module concept of arithmetic computer organization, a new possibility arises for the construction of an IPL-V hardware machine. To convert an arithmetical computer into an IPL-V system, it could be provided with a second processor that operates with certain basic IPL-V J processes as its instruction set. The second processor would require direct access to memory for its data and instructions to be able to operate at as fast a speed as the memory would allow. The instruction set of the second processor should be all the basic list operations. The remaining list operations could be built up as routines from these basic operations. All the arithmetic and input–output processes would be performed in the original arithmetic processor, with the list processor taking care of any necessary list bookkeeping. Author

N64-28452 Army Personnel Research Office, Washington, D.C.
INFORMATION ASSIMILATION FROM SYMBOLIC DISPLAYS. AMOUNT OF INFORMATION PRESENTED AND REMOVED
Seymour Ringel and Frank L. Vicino Mar. 1964 23 p refs
(USAPRO Tech. Res. Note 139; AD-600036)

The Army's command information processing systems will end-produce maps, totes, and overlays on which situation information, intelligence data, and administrative support data are presented and continually updated. The present study was conducted to determine how information assimilation is affected by amount of information presented and extent of information change introduced in updating. Slides containing military unit flag symbols such as might be depicted on maps and overlays were presented to 32 individuals. Four levels of amount of information were effected by varying the number of symbols—12, 16, 20, and 24—per slide. The initial presentation was followed by a second slide with a number of symbols—2, 4, 6, or 8—removed. Responses were analyzed in terms of accuracy and type of error.

N64-28455 General Dynamics/Convair, San Diego, Calif.
INITIAL DEVELOPMENT OF A MINIATURIZED TELEMETERING PACKAGE FOR DATA ACQUISITION AT HIGH SPEED WATER ENTRY
R. M. Hopkins Apr. 1964 61 p refs
(Contract NOw-60-0494-d)
(GD/C-64-108; AD-602028)

The shock due to high speed water entry of a body may easily reach several thousand g's, and cause serious structural damage. A telemetry package is needed that will accurately measure these accelerations. This technical note summarizes the approach, problems, and results of a program to

develop a miniaturized self-contained telemetry system for measuring the accelerations due to water entry velocities of up to 1,000 fps. Author

N64-28464 RAND Corp., Santa Monica, Calif.
THE RAND TABLET: A MAN–MACHINE GRAPHICAL COMMUNICATION DEVICE
M. R. Davis and T. O. Ellis Aug. 1964 27 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4122-ARPA; AD-444103)

This report describes a low-cost, two-dimensional graphic input tablet and stylus developed to conduct research on man–machine graphical communications. The tablet is a printed-circuit screen complete with printed-circuit capacitive-coupled encoders with only 40 external connections. The writing surface is a 10- × 10-in. area with a resolution of 100 lines/in. in both x and y. Thus, it is capable of digitizing $>10^6$ discrete locations with excellent linearity, allowing the user to write in a natural manner. The system does not require a computer-controlled scanning system to locate and track the stylus. Several institutions have recently installed copies of the tablet in research environment. Author

N64-28465 Ampex Corp., Redwood City, Calif.
APPLIED RESEARCH ON HIGH RESOLUTION SCANNING Fifth Quarterly Interim Report, 1 May 1964–1 Aug. 1964
K. F. Wallace and D. Orme 24 Aug. 1964 22 p
(Contract AF 33(657)-11091)
(RB-64-33; AD-445040)

The overall layout of the film scanner was established, and a substantial amount of detailed design work carried out. An electron gun of improved design was built and tested. It is now possible to achieve a resolution of 100 line pairs per millimeter across a flat test target 4 1/2 inches wide. In the area of electronics the main timing unit, deflection waveform generators and amplifiers, and correction waveform synthesizers and amplifiers have been designed and tested in breadboard state. Construction has started on the final units. Author

N64-28503 Illinois U., Urbana Coordinated Science Lab.
CROSSED FIELD CHARGED PARTICLE DELAY LINES
H. G. Slottow Jun. 1964 176 p refs
(Contract DA-28-043-AMC-00073(E))
(R-214; AD-602090) OTS: $3.00

Crossed electric and magnetic fields are used to focus a beam of charged particles and to control the drift velocity of these particles. The novel and useful properties are that the time delay can be varied continuously and rapidly and that the frequency band is potentially very wide. A discussion of the effects that limit bandwidth is presented, and several means for reducing the limitations are described. In particular, a hyperboloidal structure is described that can maintain equal flight times in circular delay lines; the use of plasmas is discussed, and the field-averaging properties of high-energy electrons is analyzed. Author

N64-28509 Ohio State U. Research Foundation, Columbus Antenna Lab.
ANTENNA LABORATORY PUBLICATIONS: ELECTROMAGNETIC SCATTERING, 1947–DECEMBER 1963
[1963] 58 p refs
(AD-440869)

This listing is supplied as a ready reference to publications in the general area of scattering, radar cross-section, and related topics. The compilation is in four parts—published papers, oral papers, theses and dissertations, and technical reports. The published papers are readily available in the various journals. Many of the oral papers were also published as part of a symposium or conference record. When such is the case, the paper is listed under both published papers and oral papers. Classified contractual reports are identified. Author

N64-28510 France. Ministere de l'Air, Paris
A STUDY OF A MULTICHANNEL SYSTEM OF TELEMETRY. EMISSION [SUR L'ETUDE D'UN SYSTEME DE TELEMESURES MULTICANAUX. PARTIE EMISSION]
Georges Abadie Paris, Serv. de Doc. Sci. et Tech. de l'Armament, May 1964 68 p In FRENCH *Its* Publ. Sci. et Tech., n. t. 136

The problem discussed deals with the transmission of six seismographic signals in the frequency band of 1,500 to 15,000 Hz. These signals are transformed into waves modulated in frequency and then changed to a lower frequency band. This is accomplished by six multivibrators whose frequencies are controlled by the polarization of their grids. Each multivibrator is "piloted" by a differential amplifier and a cathodyne stage. A bandpass filter at the exit of each multivibrator extracts the fundamental frequency of the signal transformed by the multivibrator. Six modulators, in ring formation, provide the desired frequency of the carrier waves that transmit the signals. Two quartz harmonic generators feed these modulators. I.v.L.

N64-28523 France Ministere de l'Air, Paris
AN INVESTIGATION OF A MULTICHANNEL SYSTEM OF TELEMETRY. RECEPTION [SUR L'ETUDE D'UN SYSTEME DE TELEMESURES MULTICANAUX. PARTIE RECEPTION]
Jean-Pierre Noblanc Paris, Serv. de Doc. Sci. et Tech. de l'Armement, May 1964 66 p In FRENCH *Its* Publ. Sci. et Tech., N.T. 137

A Hertzian link transmits seismographic signals with a period of sufficient magnitude (0.03 sec for several seconds). The signal received is a mixture of six waves obtained from six signals modulated in frequency to a principal frequency of about $F_0 = 500$ Hz. (The signal modulators are supplied by the seismograph.) The problem is to extract six bits of information from this complex wave. First the wave mixture is amplified and then separated into its components by six bandpass filters. Each of the signals is then reduced by means of six modulators, arranged in ring formation, to a principal frequency, $F_n = nf - F_0$, where $f = 2.5$ kHz, $F_0 = 0.5$kHz, and $n = 1$ to 6. Finally, six linear demodulators extract the required information. I.v.L.

N64-28533 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
THEORETICAL STUDY OF THE PROPAGATION OF INFRASONIC WAVES IN THE ATMOSPHERE. EXTENSION OF THE METHOD OF NORMAL MODES TO WAVE PROPAGATION IN AN ALMOST-STRATIFIED MEDIUM Scientific Report I
Allan D. Pierce 31 Jul. 1964 39 p refs
(Contract AF 19(628)-3891)
(AFCRL-64-526; RAD-TR-64-23; AD-603817)

A theory is presented that permits the extension of the method of normal modes to guided wave propagation in a medium with properties varying slowly with horizontal coordinates in addition to varying with the vertical coordinate. The principal assumption of the neglect of coupling between normal modes is justified so long as the horizontal wave numbers of different modes are not too closely spaced. It is predicted that different frequencies in different modes follow different

horizontal paths. A ray tracing method is described for computing these paths. The theory is then applied to the study of the dispersion of waves from an explosive source in shallow water with slowly varying depth. Author

N64-28540 Air Force Systems Command, Bedford, Mass. Decision Sciences Lab.
AN INSTANTANEOUSLY-RESPONDING EXPANSION AMPLIFIER: A METHOD AND DEVICE FOR SIGNAL ENHANCEMENT IN NOISY COMMUNICATION SYSTEMS
Laurence E. Orne and Stephen E. Stuntz Jul. 1964 23 p
(ESD-TDR-64-506; AD-604527)

Electronic communication systems become unusable when relative levels of desired signal and system noise fall below critical values, typically 6 db or less. A variable-gain amplifier having instantaneous response-time has been designed, constructed, and tested, to enable recovery of a usable audiofrequency signal from noisy analog and digital systems. For 1-db increments in signal level at or above −40 dbm, this device will provide increments on the order of 5 db, over the frequency range 50 to 10,000 cps. The rise and decay envelope is symmetrical, with slopes approximating 1 msec. This report discusses design features, including a modification for analog speech signals, and gives detailed results of laboratory and field tests. Author

N64-28602 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
THE METEOROLOGICAL SATELLITE GROUND PICTURE-RECEIVER FOR ARMY MOBILE USE
Neal W. Atkinson Nov. 1963 53 p refs
(USAELRDL-2426; AD-603335)

The meteorological satellite ground picture-receiver for Army mobile use is an experimental mobile receiving station that provides photo-facsimile reproductions of local cloud-cover pictures transmitted from an orbiting Nimbus meteorological satellite. The pictures, in the form of slow-scan video signals, are continuously and automatically transmitted from the satellite's automatic picture-transmission subsystem, while the satellite is orbiting the earth. This report covers the design of this receiving station with all necessary equipment to receive the telemetered video signals and reconstruct these signals into a near real-time cloud-cover photograph. Author

N64-28635 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
EVALUATION OF SIMPLE CODES TRANSMITTED OVER A 5000-MILE HF PATH
E. D. Moyes Jan. 1964 72 p refs
(USAELRDL-2450; AD-602032)

The use of coding for error detection and correction is of extreme importance for the reduction of error rates in the field of communications. A Bose–Chaudhuri Code and Wagner Code were implemented and tested on the ionospheric path from Kahuku Point, Oahu, Hawaii to Deal, N.J. The data obtained from these coding techniques are compared to data from a standard, noncoded channel over the identical path at the same time. Author

N64-28666 Mitre Corp., Bedford, Mass.
THE VOCODER AND OTHER VOICE (DIGITIZING) DEVICES
P. G. Edwards May 1964 32 p
(Contract AF 19(628)-2390)
(ESD-TDR-64-110; AD-601144) OTS: $0.75

Consideration is given to the progress made in methods of voice digitizing, and, in particular, to vocoders as a means of providing acceptable, secure voice transmission with a minimum expenditure of bandwidth. The present situation and future trend toward this objective are discussed. Author

N64-28682* RAND Corp., Santa Monica, Calif.
THE LINK FROM A COMMUNICATION SATELLITE TO A SMALL GROUND TERMINAL
N. E. Feldman Mar. 1964 30 p refs
(Contract NASr-21(02))
(P-2884)

This report deals with low-capacity point-to-point voice communications. Consistent with relatively simple, small ground terminals, calculations were made based on 10-ft-diameter antennas and 150° K uncooled parametric amplifiers. The resulting communication bandwith of one 4-kc voice channel, b, is a convenient base from which to scale for other antenna diameters and system noise temperature. Tabular data are presented that summarize the significant parameters for providing such a link, and illustrate the possibility of obtaining one voice channel with only small ground terminals. These data give the values of the following parameters: satellite radiated microwave power; satellite antenna gain; maximum slant range for 0-db gain; system losses; ground receiving-antenna diameter; ground receiving-antenna efficiency; system noise temperature; frequency-modulation index; feedback factor ($10 \log_{10} F^2$; C/N in the IF (4b) for one 4-kc channel that allows for a 6-db margin above the RC filter threshold; output S/N. $3m^2(\frac{C}{N})_{2b}$ for test tone; and average S/N for the average talker. I.v.L.

N64-28707* National Aeronautics and Space Administration, Washington, D.C.
WRITING THE TECHNICAL REPORT
Ethaline Cortelyou Repr. from J. of Chem. Doc., v. 4, 1964 p 141–143 refs Presented at 145th National Meeting of the Am. Chem. Soc., New York, 10 Sep. 1963
(NASA-RP-301)

A guide to the writing of a good technical report is presented, with emphasis on the functions of the author (researcher) and of the reviewer in presenting research information accurately, briefly, and comprehensively. Exception is taken to the old adage that engineers can't write, and methods are suggested for training scientists to express their own results clearly in such a manner that only an editorial review, rather than a complete rewrite, is necessary. M.P.G.

N64-28733 Weapons Research Establishment (Australia) Dept. of Supply
FPS16 RADAR TRIALS ASSESSMENT
R. H. Evans May 1963 39 p refs
(WRE-TN-SAD-113)

This report describes the methods and results of assessment of instrumentation trials designed to determine the operating performances of the FPS16 radars at Woomera. Author

N64-28737* Michigan U., Ann Arbor Radiation Lab.
STUDY OF ANTENNA PROBLEMS ASSOCIATED WITH SPACE VEHICLES Second Semi-Annual Progress Report, 1 Nov. 1963–30 Apr. 1964
T. B. A. Senior Jul. 1964 4 p
(Grant NsG-444)
(NASA-CR-58345; Rept.-5780-2-T) OTS: $1.10 ph

The design of flush-mounted (or sensibly flush mounted) antennas for space-vehicle application is a difficult problem if a close fit to a specified radiation pattern is desired; this

is particularly true when the requirement is for omnidirectionality. This report reviews studies that were and are being conducted in association with the realization of specified sources on curved surfaces. It was found that the achievement of a desired coverage in the fore-and-aft direction of a space vehicle is neither as important nor as difficult as the realization of a particular azimuthal pattern. As a contribution to the former problem, the effect of a surface "kink" (such as at the joint of a cone and a cylinder) is being rigorously analyzed. I.v.L.

N64-28749 National Bureau of Standards Boulder, Colo. Central Radio Propagation Lab.
CALCULATED DIFFRACTION EFFECTS AT VLF/FROM A LOCALIZED IONOSPHERIC DEPRESSION
James R. Wait 16 Jan. 1964 16 p refs
(ARPA Order 183-62)
(NBS-TN-208) GPO: $0.15

Propagation of VLF radio waves in the earth-ionosphere waveguide of nonuniform width is considered. The disturbed region is permitted to be of finite extent. It is assumed that the height variations may be locally represented in terms of a propagation function S(x,y) that is a function of both x and y. Using first-order scattering theory, calculations are presented for a disturbed region that is approximately rectangular in the horizontal plane. Author

N64-28756* Ohio State U. Research Foundation, Columbus Antenna Lab.
RADIATION CHARACTERISTICS OF A PLANAR BROADSIDE ARRAY OF DIRECTIVE ELEMENTS
Joseph A. Kinzel 15 Apr. 1964 79 p refs
(Grant NsG-448)
(NASA-CR-58355; Rept.-1691-6) OTS: $7.60ph

One criterion for the optimum spacing of the elements of planar broadside antenna arrays, considered for communicating with deep space, is that of converting the directivity of an array element to an effective aperture and spacing the elements accordingly. This report is directed toward the exploration of this aperture concept by using as an example a four-element planar broadside array. Theoretical results for directivity, using the function $\cos^n\theta$ to approximate the individual element sources, were obtained. By varying the parameter n it is possible to simulate endfire element patterns of any desired directivity. Experimental radiation patterns were then obtained for an array of helices having the geometry of the array under consideration, for various spacing of the three peripheral elements with respect to the middle element. According to calculations, the aperture concept, i.e., spacing directive elements by the diameter of the circle that represents the equivalent aperture, results in near-optimum design in regard to spacing. In addition, the measured patterns agreed with those calculated by pattern multiplication for spacings greater than 1.2 wavelengths. I.v.L.

N64-28768 Gt. Brit. Dept. of Scientific and Industrial Research
RADIO RESEARCH, 1963
London, HMSO, 1964 36 p refs HMSO: 3s

Progress is described of research in ionospherics, in the earth's gravitational field, and in radiometeorology. Summaries of programs at outstations and at the Radio Research Station are included. D.E.W.

N64-28783 Aerospace Industries Assn. of America, Inc., Washington, D.C.
DEVELOPMENT OF A CONSTANT BANDWIDTH FM STANDARD
Jun. 1964 60 p
(ARTC-39)

To satisfy the need of the aerospace industry for a larger number of medium- to high-frequency response data channels, a set of 22 constant bandwidth subcarrier channels was proposed to augment the proportional bandwidth standards. A prototype constant bandwidth system was built and evaluated. Constant bandwidth was achieved by specifying a subcarrier deviation of a given amount (either ±2 kc or ±4 kc) rather than an amount that is proportional to the center frequency of the subcarrier. Test results presented in detail indicate that the proposed standard describes a practical and feasible telemetry system with an acceptable degree of accuracy and freedom from noise. The overall system average noise output was found to be 1% for a modulation index of 5; this average could be reduced to even lower values when the upper channels were not used. The proposed guard band of 4.3 kc between adjacent channel edges was found to be adequate. The tradeoff of average output noise from 1% to 1.6% gives an increase of 2 1/2 times in information bandwidth per channel (modulation index of 2), which would be useful for applications such as relaying flight-test data. M.P.G.

N64-28794 Pacific Missile Range, Point Mugu, Calif. Instrumentation Systems Div.
CORRECTION OF NEAR-HORIZONTAL RADAR ELEVATION ANGLES FOR ATMOSPHERIC REFRACTION
L. T. Bankston and D. B. Meeker 6 Jul. 1964 28 p
(PMR-TM-64-6; AD-602280) OTS: $0.75

AN/FPS-16 radars at Point Mugu, San Nicolas Island, and Tranquillon Peak, California, observed the variability with time and space of the position parameters (mostly elevation angle) of a fixed transponder beacon on Santa Cruz Island, California. Soundings with an airborne refractometer were taken along the Point Mugu–Santa Cruz Island path, and radiosondes were released at Point Mugu, while radars at Point Mugu collected elevation angle observations. A ray-trace computer program operated on the sounding data to compute predicted elevation angles at the radar. Observed and predicted angles were compared. It was concluded that errors in the observed elevation angles were due mainly to atmospheric refraction. The variability with time and space of propagation conditions made the slowly acquired and inaccurately positioned sounding data inadequate to achieve corrections commensurate with the inherent accuracy of the AN/FPS-16 radar. If accurate low-angle position data are required, methods other than soundings with aircraft-borne refractometers and balloon-borne meteorological sensor packages should be sought and developed. Author

N64-28823 SHAPE Air Defense Technical Center, The Hague (Netherlands) Communications Div.
PRELIMINARY RESULTS OF ANTENNA HEIGHT-DIVERSITY TESTS ON AN IONOSCATTER SYSTEM
P. J. Bartholomé Mar. 1964 21 p refs
(TM-92; AD-442274)

Previous experiments showed the feasibility of a compact ionoscatter telegraph system operating over a distance of 1,000 km. The frequency was in the 36-mc/s band. Yagi antennas and 5-kw transmitters were used. Space diversity was obtained at the reception in the conventional way, i.e., by placing the various antennas at the same height and several wavelengths apart in a direction perpendicular to the propagation path. A different type of diversity, namely antenna-height diversity, which was not applied previously to an ionoscatter communications system, was tried on the same circuit. The results of a first series of experiments are presented. It is shown that for a dual-diversity system consisting of Yagi antennas stacked at heights of 10 and 21 m on the same

mast, the diversity gain is practically equal to that of a system using similar antennas with 50-m (6 λ) horizontal spacing. Author

N64-28824 Lincoln Lab., Mass. Inst. of Tech., Lexington
THE ORTHOMATCH DATA TRANSMISSION SYSTEM Technical Report No. 346
B.G. Kuhn 18 Feb. 1964 61 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-35; AD-602130)

Orthomatch is a high-performance data transmission or telemetry system that uses envelope-orthogonal signals in the transmitter and matched-filter detectors in the receiver. Because of the parallel coding and optimum detection techniques of Orthomatch, its calculated performance equals or betters the calculated performance of other available telemetry systems. It is within 10.2 db of Shannon's ideal system. A practical Orthomatch system, operating with 16 levels of amplitude resolution and a 40-kc/s word rate (160-kc/s bit rate), has been assembled in field-prototype form and tested with transmitter and receiver components at 2.22 gc/s. Signal-in-noise performance of this practical system was found to be within 1.5 db of calculated performance. Author

N64-28842* Purdue U., Lafayette, Ind. Electronics Systems Research Lab.
THRESHOLD SELECTION AND DETECTOR PERFORMANCE WITH UNKNOWN NOISE COVARIANCE Memorandum Report 64-1
W. D. Gregg 29 May 1964 35 p refs
(Grant NsG-553)
(NASA-CR-58349) OTS: $3.60 ph

Particular results of Keehn are applied to the problem of coherent detection of white, bandlimited, stationary, gaussian signals in additive white, bandlimited, stationary, gaussian noise with unknown covariance. The results indicate that the critical term in the a posteriori probability expression, arising from Bayes' theorem, is the Wishart density, $W(2WT, n_1, \phi_1)$, and is maximized when the norm, $\| Z\text{-}S_i \|$ is minimized. The results are extended to include an illustration of threshold selection and an evaluation of detector performance. Threshold selection based upon estimation leads to detector performance that is a random variable. The probability law for detector performance and the expected performance and variance of performance are developed. Demonstration of the convergence of the expected performance and variance of performance to the specified performance and zero respectively is given. An approximation of the probability law associated with a hypothesis testing variable is used to obtain closed form expressions. An investigation of error in the approximation is included. Author

N64-28901 Naval Civil Engineering Lab., Port Hueneme, Calif.
EVALUATION OF AN IMPROVED RFI-SUPPRESSING POWER CONDUCTOR
Don B. Clark and J. L. Brooks 13 Jan. 1964 27 p refs
(R-275; AD-427189)

An improved power conductor for suppressing radiofrequency interference (RFI) was developed, consisting of #2 AWG stranded copper wrapped with two layers of 7-mil silicon iron (SiFe) magnetic tape and a 50-mil extruded polyvinyl chloride jacket. To evaluate its capability for attenuating RFI and its resistance to deterioration, the lossy conductor was installed on a 3-mile, 3-conductor, 4-kv power line on San Nicolas Island, off the coast of Southern California. Attenuation exceeded that reported for the Fort Huachuca lossy line, at frequencies below 1 mc, and was equal or greater at higher frequencies. The stranded conductor's effect on attenuation is discussed, and curves are included for comparing the attenuation of solid and stranded conductors wrapped with lossy tape. Ambient noise levels are shown. The severe climate and its effect on the power line are discussed; test methods are described; and future developments are considered. Author

N64-28931* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRACKING SYSTEMS, THEIR MATHEMATICAL MODELS AND THEIR ERRORS. PROGRAM DESCRIPTION
J. L. Cooley 20 May 1964 69 p refs
(NASA-TM-X-55052; X-513-64-145) OTS: $6.60 ph

The mathematical models of various types of tracking systems and the methods used in solving the error equations were given in Part 1 of this three-part report. This paper presents the input and output requirements of the associated error-analysis computer program ERRAN, and will be incorporated into Part III—a complete description of all the features of the program. The inputs necessary for running a case, for stacking cases, and sample inputs with and without options are given, along with the various outputs possible. The coding for the main program is done in FORTRAN II and FAP. The program requires about 90% of the storage capacity of the 32K IBM-7094 computer. D.S.G.

N64-28936* Space Technology Labs., Inc., Redondo Beach, Calif.
INVESTIGATION AND ANALYSIS OF THE INFLUENCE OF PERTURBING FORCES ON TRACKING OF ORBITAL VEHICLES
E. M. Boughton, T. H. S. Brown, M. P. Francis, B. Hamermesh, F. J. Lombard et al 28 Jun. 1964 115 p refs
(Contract NAS8-11073)
(NASA-CR-58248) OTS: $9.60 ph

The purpose of the study was to determine the effects of various perturbing forces on the earth parking orbit and translunar phases of a lunar mission. The perturbations studied were divided into thrust perturbations and natural perturbations. The thrust perturbations include gas leakage and venting, while the natural perturbations include gravitational models, solar radiation pressure, and atmospheric drag. Thrust perturbations and natural perturbations are discussed. The effects of both the entire force and the uncertainty in the force are considered. Special emphasis was placed on the effects of venting or gas leakage thrusts on earth orbits. The total effects, tracking effects, and uncertainty effects of these thrusts are all included. Author

N64-28937* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
AN INTEGRATED THEORY OF LINGUISTIC DESCRIPTIONS Special Technical Report No. 9
Jerrold J. Katz and Paul M. Postal 1964 187 p refs Its Res. Monograph No. 26
(Grants NsG-496; NSF G-16526; NIH G-MH-04737-03; Contracts AF 19(628)-2487; DA-36-039-AMC-03200(E))
(NASA-CR-58224) Available from MIT: $5.00

The syntactic and semantic components of a linguistic description of a natural language are described, and examples are given. Projection rules are discussed, as are apparent counter examples. A heuristic principle for linguistic analysis is stated, and conclusions concerning the syntactic component of language, as well as the universals in linguistic descriptions, are explained. Models for speech recognition and production are discussed, and linguistic theory is applied to various theories of language learning. D.E.W.

N64-28942* Purdue U., Lafayette, Ind. School of Electrical Engineering
ON A CLASS OF APPROXIMATION PROBLEMS IN SIGNAL DESIGN
J. C. Hancock and R. E. Totty Aug. 1964 126 p refs
(Grant NsG-553)
(NASA-CR-58495; TR-EE-64-13) OTS: $10.10 ph

For a large class of receivers, the so-called correlation detectors or matched filters, an error analysis free of the signal and filter detail can be carried out. Some of the factors that may cause the actual performance of matched filter receivers to be less than their expected performance are as follows: (1) The matched filters may deviate from their intended design or the transmitted signals may be different from their designed waveforms. (2) The channel may alter the waveforms of the transmitted signals. (3) If a discrete receiver is used, it may not be a sufficiently good approximation of the analog receiver. The effect of these discrepancies on probability of error for three binary systems is considered. Bounds are obtained on degradation of performance of on–off, antipodal, and orthogonal signal systems due to mismatching of the signals or the filters. It is shown that the equal-energy orthogonal-signals system is potentially the most sensitive of the three systems considered, and that for this case, mismatching of the signals is more serious than the same amount of mismatch in the filters. Author

N64-28965* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE ROLE OF PSEUDORANDOM CODES IN COMMUNICATIONS
Robert C. Titsworth 3 Aug. 1964 14 p refs Presented at the Intern. Symp. on Global Commun., Philadelphia, 2–5 Jun. 1964
(Contract NAS7-100)
(NASA-CR-58240; JPL-TM-33-185) OTS: $1.60 ph

Periodic sequences having certain inherent randomlike statistics are called pseudorandom sequences. The most important randomness criterion, insofar as communications of a gaussian channel is concerned, is the resemblance that the cyclic autocorrelation function of a sequence bears to that of a sequence of coin tosses. The match between these two correlation functions is a function of the cycle length of the periodic code and can be measured in degrees of phase orthogonality. Many communications systems use this phase orthogonality for information distinguishability in many diverse ways, depending on particular applications. This report summarizes the kinds of pseudorandom sequences, and the differing criteria under which they are studied, and indicates applications wherein they have been found useful. Author

N64-28970* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DESIGN OF A VERY HIGH POWER, VERY LOW NOISE CASSEGRAIN FEED SYSTEM FOR A PLANETARY RADAR
Philip D. Potter 24 Aug. 1964 21 p refs
(Contract NAS7-100)
(NASA-CR-58674; JPL-TR-32-653) OTS: $2.60 ph

A modified Cassegrain feed for an 85-ft-diam-antenna planetary radar system is described. The radar system operates at a frequency of 2,400 mc in a duplex mode with a transmitter power of 100 kw CW and an overall receiving system noise temperature of about 28° K. The feed system utilizes a nonoptical subreflector and a suppressed sidelobe feedhorn to achieve an overall aperture efficiency of 0.65 and a zenith antenna noise temperature of 10° K, including atmospheric effects. A versatile polarizing system provides for either sense of circular polarization or for any orientation of linear polarization. Detailed design and performance information is presented. Author

N64-28971* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
METHODS FOR OBTAINING VELOCITY AND RANGE INFORMATION FROM CW RADARS
Mahlon Easterling 1 Sep. 1964 22 p refs
(Contract NAS7-100)
(NASA-CR-58600; JPL-TR-32-657) OTS: $2.60 ph

Continuous wave radars are particularly suited for obtaining velocity and range information on single targets at extreme ranges whether they be spacecraft in orbit about the earth or enroute to the Moon or another planet, or natural celestial bodies such as the Moon or inner planets. The carrier itself provides the means for determining the velocity of the target because of the doppler shift of the returned signal. Ways of measuring this doppler shift for both coherent and noncoherent returned signals are discussed. The determination of range requires that the carrier be modulated. Methods of deriving modulating waveforms from pseudorandom sequences are given, which are suitable for achieving high resolution and accuracy and resolving ambiguity. Ways of extracting the range from a returned signal are also given. Author

N64-29014 Cubic Corp., San Diego, Calif.
MATTS FREQUENCY FEASIBILITY STUDY
William W. Metz Jul. 1964 217 p refs
(Contract AF 08(635)-2805)
(ATL-TDR-64-38; AD-445280)

Results of a 6-month study to investigate and evaluate all factors relating to changing the operating frequencies for the Multiple Airborne Target Trajectory System (MATTS) are reported. Methods are described to provide push-button selection of IRIG telemetry frequencies over 225 to 260 mc for AME receivers, and compatible, shop-tunable, airborne signal sources. Development of advanced, transistorized, low-noise RF preamplifier and simplified tunable local oscillator is reported. Findings of antenna field investigation into phase-error effects of multipath, antenna field surface, antenna polarization, nonparallel illumination, and random time-varying refraction are documented. As alternative to tunable VHF operation, equipment required for fixed-frequency operation on S-band protected scoring frequencies is described. Findings are reported on means for telemetering interceptor attitude data (heading, pitch, roll, acceleration) and adding to computer tape format. A phase comparison telemeter is described that offers simplicity of FM/FM and accuracy comparable to PCM/FM. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-27896 Massachusetts Inst. of Tech., Cambridge
DIELECTRIC PARAMETERS AND EQUIVALENT CIRCUITS
B. B. East and W. B. Westphal May 1964 66 p refs
(Contract AF 33(616)-8353)
(TR-189; AD-601522)

This report is an introduction to dielectric measurements as a spectroscopy tool. Equivalent electrical circuits are used to simulate the frequency response of materials. A number of frequency plots are presented with various parameters used by engineers and optical spectroscopists. Examples show differences between materials having two relaxation processes or a distribution of relaxation times and between materials having a damped vibration spectrum or a relaxation spectrum. Using the relations between the parts of a complex parameter, a useful limit is given for the change in dielectric constant with frequency. Author

N64-27899* Texas Instruments Inc., Dallas
A STUDY PROGRAM TO DETERMINE MAGNETIC PROPERTIES OF JPL SPACECRAFT ELECTRONIC COMPONENTS Final Report
Jan. 1964 67 p refs Prepared for JPL
(Contracts NAS7-100; JPL-BE-4-217626)
(NASA-CR-56452) OTS: $6.60 ph

A stochastic approach to the problem of allowable magnetic moments in a space vehicle is presented. The probability density functions for three magnetic-field components at a sensor is determined in terms of random variables describing the position, orientation, and magnetic moment of a statistical dipole in a spherical coordinate system. The resultant probability density functions are expressed as multiple integrals of functions of these random variables and of the Jacobian of the transformation. R.T.K.

N64-27922 Harry Diamond Labs., Washington, D.C.
THE CONSTRUCTION OF A TWO-SECTION TRANSFORMER HAVING A TOTAL LENGTH LESS THAN A QUARTER WAVELENGTH
Danny W. Mc Donald and Burton J. Udelson 30 Apr. 1964 18 p refs
(HDL-TR-1223; AD-601498)

An experiment was performed to verify the authors' new concept that a two-section transformer may be designed in which the length of each section is less than a quarter wavelength and may be treated as an independent variable. A two-section J-band waveguide transformer, having an arbitrarily chosen total length of one-fifth of a guide wavelength, was designed to match a 4:1 impedance mismatch at 5,500 mc. The design procedure is described in detail, including corrections for capacitive reactances introduced by each step discontinuity in the waveguide. The experimental results are in excellent agreement with the design objective. Author

N64-27923 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
DESIGN OF VHF CRYSTAL FILTERS USING THE INDUCTIVELY COUPLED LATTICE EQUIVALENT
Joseph M. Giannotto 19 Mar. 1964 31 p refs
(USAELRDL-TR-2425; AD-601314)

The inherently high Q and excellent temperature characteristics of the quartz crystal now permit the development of a line of precise band-pass filters for VHF applications and an ideal replacement for the less stable LC filters presently in use. The inductively coupled lattice-equivalent design technique was used to design and fabricate crystal filters in the frequency range of 30 to 75 mc with bandwidths of 50 and 250 kc. This report presents specific design data and response characteristics of the fabricated filters. Author

N64-27973* Northrop Corp., Palos Verdes Estates, Calif. Electronic Systems and Equipment Dept.
INVESTIGATION OF PROBLEMS ASSOCIATED WITH THE DETECTION OF THE LUNAR HORIZON FROM A SPACE VEHICLE Final Report
D. E. Conklin May 1964 102 p refs
(Contract NAS8-11039)
(NASA-CR-56840; NORT-64-177)

Switching circuits were demonstrated that will operate at a 10:1 signal-to-noise ratio with a 1 microvolt signal at a chopping rate of 15 cps. The switching transistors used in these tests are insulated gate field effect transistors (FET). Investigations showed that these FET devices had a higher interelectrode capacitance than was specified by the manufacturer. The apparent cause of this high capacitance is a desiccant enclosed within the transistor case. Later models of this FET, constructed without the desiccant, are reported to have an order-of-magnitude lower interelectrode capacitance. The present quotient circuitry develops an output signal that is directly proportional to the ratio of two voltages from the detector pair under surveillance. Since information is extracted only from the ratios of signals, scale factor is independent of signal amplitudes. Thus, the data are self-normalizing, and there is no need for automatic gain control to provide constant scale factor. A thermopile detector was tested that has 120 thermocouples arranged so that the active junctions form a rectangle of 1 × 8 mm. This detector was tested for characteristics of responsivity, time constant, frequency response, and uniformity. The results prove the feasibility of using a thermopile detector for lunar horizon detection. Author

N64-27997 Utah U., Salt Lake City Microwave Devices Lab.
ELECTRON BEAM STUDIES
L. S. Bowman, O. Barker, R. W. Grow et al *In its* Consolidated Quart. Rept., Jan. 1–31 Mar. 1964 31 Mar. 1964 p 1–32 refs
(See N64-27996 23-20)
(Contract AF 33(657)-8677)

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N64-28006 Illinois U., Urbana Coordinated Science Lab.
APPLICATION OF LINEAR GRAPHS TO ELECTRICAL NETWORKS, SWITCHING NETWORKS AND COMMUNICATION NETS
W. Mayeda Apr. 1964 149 p refs
(Contract DA-36-039-AMC-02208(E))
(R-203; AD-601197)

An analysis was made, by linear graphs, of passive networks as well as of active networks. The application of linear graphs to switching networks and to communication nets is described. G.D.B.

N64-28012 European Organization for Nuclear Research Geneva (Switzerland) Data Handling Div.
PROCEEDINGS OF THE INFORMAL MEETING OF FILMLESS SPARK CHAMBER TECHNIQUES AND ASSOCIATED COMPUTER USE
G. R. Macleod and B. Maglic, ed. 16 Jun. 1964 396 p refs (CERN-64-30)

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N64-28014 Westinghouse Electric Corp., Washington, D.C.
HIGH CURRENT AND HIGH VOLTAGE SILICON CONTROLLED RECTIFIERS Quarterly Reports, 1 Oct. 1963–31 Mar. 1964
R. Kuehn et al [1964] 46 p refs
(Contract NObsr-87647)
(QR-6; QR-7; AD-442070)

Testing facilities for evaluation of thermal impedance, peak forward drop, and 10,000 amp surge current are described. Transmission electron microscope study on materials under the influence of processing was used to assist process control. Effects of crystal materials on junction characteristics are described. The studies confirm the use of 1.125-in.-diam material as the best choice for the state-of-the-art development. Author

N64-28022 Hyletronics Corp., Burlington, Mass.
THE ROTATING FIELD PHASER Final Report
Jerald A. Weiss [1963] 72 p refs Prepared Under Subcontract for Lincoln Lab.
(Contract AF 19(604)-7400)
(ESD-TDR-64-422; AD-601320) OTS: $7.60

Results are given of an investigation directed toward the development of a rotating-field phaser (the term "phaser" is used to denote any transmission line device that provides variable electrical length while maintaining low and, ideally, constant insertion loss) that utilizes the microwave properties of ferrite. An outline is presented of the principles of operation, beginning with the elementary and idealized circuit-theory considerations of the continuously variable rotating half-wave plate phaser and proceeding to the use of the gyromagnetic properties of ferrites as a means for achieving electronic phase control. The circuit theory is then extended to include an analysis of the scattering due to mismatches and faulty conversion from circular to linear polarizations. Experiments that gave the most significant results at X-band on phase, insertion loss, and VSWR (voltage standing wave ratio) are discussed. R.T.K.

N64-28060 Weapons Research Establishment (Australia) Dept. of Supply
TIM SEARCH. TIME COINCIDENCE SEARCH UNIT
F. A. Hinc and M. C. Payten Mar. 1963 85 p refs
(WRE-TN-EC-2)

A time coincidence search unit has been designed and built, which checks for coincidence between times that can be preselected on switches mounted on the equipment and times encoded in a TIM pulse train. This latter is derived from magnetic tape records of parameters and TIM time coded signals recorded during missile trials. This note includes a discussion of the facilities provided by this equipment and a description of its operation in terms of functional diagrams. The circuits are analyzed in detail; engineering design and constructional features are also described. Author

N64-28150 Collins Radio Co., Newport Beach, Calif.
FILTER CRYSTAL DEVELOPMENT PROGRAM (70 TO 160 MC) First Quarterly Report, 15 Jul.–15 Oct. 1963
R. A. Auriemma and W. D. Peterson 25 Mar. 1964 11 p refs
(Contract DA-36-039-AMC-03207(E))
(Rept.-1; AD-437224)

A study of the relationship between spurious response and the mechanical tolerances and fabrication process techniques was initiated. Areas in which experimental work needs to be done were defined. Data requirements and methods of collecting data were studied. Author

N64-28220* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF ACCUMULATED HYDROGEN ON CIRCUITRY IMBEDDED IN POLYURETHANE FOAM
Lester L. Mohr *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 6 p refs (See N64-28201 20-23) OTS: $19.75 ph

The work was undertaken to determine whether bombardment of polyurethane foam by protons and a resulting accumulation of hydrogen in the foam could cause changes in the electrical characteristics of the foam that might be mistaken for changes in the electrical characteristics of circuits embedded or "potted" in the foam. Assuming that protons with energy spectra similar to those of space sources might cause charges in the organic structure of polyurethane molecules, or might cause accumulation of occluded gases (mostly hydrogen or hydrogenous in nature), experiments were designed to simulate and to determine the effect of typical voltages in producing parasitic currents, directly attributable to breakdown of the foam environment, which could be confused with electrical-component damage caused by irradiation. Author

N64-28250 Lehigh U., Bethlehem, Pa. Inst. of Research
TRANSISTOR CHARACTERIZATION AND ACTIVE NETWORK STUDIES Interim Technical Report
31 Mar. 1964 22 p refs
(Contract DA-SIG-36-039-60-G2)
(AD-600001) OTS: $2.00

The PIN diode is under study with special attention toward its properties as a charge storage device and as a microwave switch. The charge storage studies consist of a theoretical calculation of the length of the storage time and of the amount of charge remaining at the end of this period; a calculation of the time in which the reverse current decays to zero; and an experimental investigation of the reverse transient using pulse and sinusoidal signals. Diodes of different structures were tested for snap-off applications; the diode with most favorable properties showed a lifetime of about 100 nanosec and snap-off times in the range of 1 to 3.5 nanosec. PIN diode microwave switches have been designed to operate with direct current bias generated from the microwave signal itself. Author

N64-28277 Illinois U., Urbana Coordinated Science Lab.
SOME APPLICATIONS OF LINEAR GRAPHS
Wai-Kai Chen May 1964 51 p refs
(Contract DA-28-043-AMC-00073(E))
(R-211; AD-601623)

Papers covered in this report are concerned with the following: (1) the modification of the weights associated with the self-loops in the Mason or Coates flow graphs so that more efficient topological formulas can be obtained; (2) the development of some relations and properties between flow graphs and bipartite graphs, and the use of bipartite graphs as an intermediate step in the simplification of the corresponding flow graphs; (3) an extension of the star-mesh transformation, where it is shown that Yoeli's process can be accomplished topologically; (4) a new method of solving a system of simultaneous linear equations based on the reduced flow graphs; and (5) the generalization of a single-node removal algorithm to a multiple-node removal algorithm. I.v.L.

N64-28279 Emmanuel Coll., Boston, Mass. Research Language Center
A NEW WAY OF COUPLING TWO COMPLEMENTARY TRANSISTORS [NOVA VAZBA KOMPLEMENTARNEJ DVOJICE TRANZISTOROV]
Viktor Spany Bedford, Mass., AFCRL, Mar. 1964 15 p refs Transl. into ENGLISH from Salborproudy Obzor, (Prague), no. 12, 1961 p 671–674
(Contract AF 19(628)-3869)
(E-T-SLOVAK-64-1; AD-442421)

This article describes the operation of a new flip-flop circuit in bistable and astable conditions. The astable condition enables the formation of sawtooth waveforms. In this case, the peak-to-peak voltage almost equals the voltage of the source feeding the circuit. In the nonregenerative condition of a complementary system of two transistors with common emitters, various sawtooth waveforms may be formed, and multiple integration may be achieved. Author

N64-28282 Lincoln Lab., Mass. Inst. of Tech., Lexington
A MORE PRECISE ANALYSIS OF MULTICAVITY KLYSTRONS. II. PREDICTION OF ELECTRONIC CONDUCTANCE AND OVER-ALL GAIN Technical Report 348
R. L. Pease 14 Feb. 1964 38 p refs
(Contract AF 19(628)-500; ARPA Order 85)
(ESD-TDR-64-33; AD-441855)

Exact solutions for space-charge waves in a klystron, derived in a previous report, are introduced into a matrix scheme for the computation of electronic conductance and overall gain of multicavity klystrons. This scheme was programed for the IBM 7090, and the numerical predictions are compared with experimental results for four tubes. The predicted gain-vs-frequency curves have the same shape as the experimental curves and lie from 1 to 8 db above them, depending upon the tube. Author

N64-28308 Autonetics, Anaheim, Calif.
A PROTOTYPE ELECTROLUMINESCENT SPACECRAFT DISPLAY
John Frost Mar. 1964 18 p

This paper concerns the design and construction of a compact, medium-resolution electroluminescent display package, devised to solve a representative problem in spacecraft visual instrumentation. The device is designed to operate from either analog transducer inputs or directly from a central digital computer. Author

N64-28314* Texas Instruments Inc., Dallas
DEVELOPMENT OF A POWER SILICON GATE CONTROLLED SWITCH
Max P. Schreiner Washington, NASA, Sep. 1964 56 p refs
(Contract NAS8-2638)
(NASA-CR-94) OTS: $1.50

The report describes the development programs initiated to meet the device requirements of high voltage–high current switching at turnoff gains and power switching levels not obtainable from existing commercial devices. The theory of gate control switch design is discussed, and a summary of three project programs is given: lifetime control, geometry effects, and diffusion technology. Device fabrication and evaluation techniques are described with the device experimental data and results. Author

N64-28346 Joint Publications Research Service, Washington, D.C.
SIMULATION AND CONTROL OF PHYSICAL AND CHEMICAL SYSTEMS
20 Aug. 1964 44 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 3, 1964
(JPRS-26028; TT-64-41298) OTS: $2.00

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N64-28347 Joint Publications Research Service, Washington, D.C.
DISCRETE INDICATOR OF THE LIMITING VALUE OF THE PRODUCT OF TWO CONTINUOUS VOLTAGES
E. A. Yakubaytis, M. P. Vayvars, and T. A. Frantsis *In its* Simulation and Control of Phys. and Chem. Systems 20 Aug. 1964 p 1–12

The present article examines a discrete device that signals the attainment of a given value by a product of two continuous voltages. The characteristic feature of the device is that there are no converters in it of continuous-to-discrete voltage. The principle of operation of the circuit is based on the fact that for a given product value, a fully fixed multiplier value corresponds to each multiplicand value. Therefore, for each known multiplicand value, the product is simultaneously determined by a multiplier value. Author

N64-28348 Joint Publications Research Service, Washington, D.C.
DIAGNOSIS OF SYSTEMS BY BUILDING THEIR MODELS
L. A. Rastrigin *In its* Simulation and Control of Phys. and Chem. Systems 20 Aug. 1964 p 13–20

A method is proposed of diagnosing systems by constructing their models with the use of multiparameter optimization. The method makes it possible to determine parameters of systems with restriction. The use of the method is illustrated in an example of diagnosis of a linear quadripole. The general problem of diagnosis of system includes the determination of a series of parameters of a diagnosing system both in tests and in normal operation. Author

N64-28366* Field Emission Corp., McMinnville, Ore.
INVESTIGATION OF THE PRE-BREAKDOWN GAP CURRENTS LEADING TO ELECTRICAL BREAKDOWN BETWEEN CLEAN AND CESIUM-COATED TUNGSTEN ELECTRODES
R. W. Strayer, C. J. Bennette, E. C. Cooper, and L. W. Swanson N.Y., AIAA [1964] 12 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–Sep. 1964
(Sponsored by NASA)
(AIAA Paper-64-694) AIAA: $0.50 members, $1.00 nonmembers

Prebreakdown currents were measured between tungsten electrodes with varying degrees of cesium coverage and with varying amounts of oxygen contamination under both high vacuum conditions and in the presence of a cesium pressure of 2×10^{-6} torr. In all cases the emission mechanism was field emission from small projections on the cathode; the corresponding current-voltage characteristics were stable and reproducible. The main effect of surface adsorbates was to change the work function of the emitting surface. The gap voltage for a permitted gap current was thus a function of surface of roughness and of amount of contamination upon the electrodes, as well as of gap spacing. Typical values of the voltage gradient for 0.1 μa gap current are 8 kv/mil for clean tungsten and 1.6 kv/mil for an optimum cesium coverage. The local electric fields at the tips of projections on the electrodes are higher, up to 70 Mv/cm. At these high local fields for clean tungsten, the gap current was unstable and increased with time at constant voltage, leading to electrical breakdown. Evidence for field and temperature induced geometrical changes of the surface is given and discussed. Author

N64-28443 Joint Publications Research Service, Washington, D.C.
SELF TEACHING SYSTEMS WITH POSITIVE FEEDBACK
A. G. Ivakhnenko 27 Jul. 1964 280 p refs Transl. into ENGLISH of the book "Samoobuchayushchiyesya Sistemy" Kiev, Acad. of Sci. Ukr. SSR, 1963 p 1–328
(JPRS-25603; TT-64-31875) OTS: $6.00

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4. SELF-TRAINING SYSTEMS WITH POSITIVE FEEDBACK LOOPS p 139–271
5. BIBLIOGRAPHY p 272–278

N64-28502 Sperry Microwave Electronics Co., Clearwater, Fla.
PRODUCTION ENGINEERING MEASURE YIG SPHERES AND LIMITERS Third Quarterly Progress Report, 29 Nov. 1963–29 Feb. 1964
J. Andrews and D. Tribby [1964] 32 p
(Contract DA-36-039-AMC-01477(E))
(SJ222-0045-3; AD-601073)

An improvement was achieved in sphere surface finish, resulting in reduced linewidths. A technique for establishing a correction factor was devised, which enhances the accuracy of the linewidth measurement system. Limiters were tested at high power in S-band with preliminary tests performed in L-band. Temperature stability testing was initiated in C-band. Ten batches of single-crystal material were fired this quarter. Satisfactory progress was indicated in the quality of the crystals derived. Author

N64-28520 SFD Labs., Inc., Union, N.J.
DEVELOPMENT OF A Ku-BAND CROSSED-FIELD AMPLIFIER Final Development Report, 27 Jun.–27 Mar. 1964
John Mc Bride and Fred Feulner May 1964 50 p refs
(Contract NObsr-89517)
(SFD-32-F; AD-601056)

This is an engineering report on a Ku-band crossed-field amplifier development program. The approach used is essentially one of scaling the slow wave circuit of a proven X-band crossed-field amplifier. Electrical and mechanical design factors and subsequent modifications thereto are treated in detail along with a description of the test equipment used to evaluate the design. Operating performance data reveal the reentrant stream backward wave crossed-field amplifier, as developed on this program, to be capable of gains in excess of 20 db over a wide frequency band. The tube has also demonstrated a peak power output of 200 kw. These data are indicative of the characteristics of this particular slow wave circuit (a choke supported interdigital line) and the relative ease of its adaptability to other frequency bands. Author

N64-28539 Aerospace Corp., El Segundo, Calif. Electronic Div.
A STUDY OF OPTIMAL LINEAR ESTIMATION FOR A HORIZON SCANNER
James S. Meditch 25 Aug. 1964 20 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-147; TDR-269(4540-70)-7; AD-604180)

The theory of optimal linear filtering was applied to the problem of estimating the pitch attitude of an orbiting spacecraft. The horizon scanner model assumed includes the effects of instrument dynamics, instrument noise, and external noise, such as that due to cold clouds and uncertainty in the definition of the horizon. The entire system, including the process model and the optimal filter, was simulated on an analog computer, and the results are discussed and evaluated. Author

N64-28542 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
MICROWAVE ACOUSTIC DELAY LINE AND RELATED ACTIVE DEVICES
Griffiss AFB, N.Y., RADC, Jul. 1964 116 p
(Contract AF 30(602)-3076)
(RADC-TDR-64-246; AD-604250)

Generation of useful RF power outputs in CdS crystals was demonstrated with outputs up to 156 mv at the terminals without the need for transducers. High-efficiency (3-db conversion loss) diffusion-layer integral transducers were achieved in ultra-high-purity CdS crystals. Feasibility of complete functional devices from a single crystal of material was shown with integral delay lines and amplifiers. The use of thermal heat sinks and proper choice of crystal geometry were shown to overcome most of the obstacles to achievement of continuous operation of electroacoustic devices. Initial results included satisfactory operation of a CdS oscillator at a duty factor greater than 0.1. Author

N64-28545 New York U., N.Y. Lab. for Electroscience Research
THE USE OF SENSITIVITY AS A CRITERION IN THE SYNTHESIS OF ACTIVE NETWORKS
A. Grabel Jul. 1964 115 p refs
(Contract AF 33(657)-8817)
(AL-TDR-64-165; AD-603857)

The problem of simultaneous realization of a network function and a sensitivity function is considered. The simultaneous consideration of pole and zero sensitivity is included by using the real frequency sensitivity. The method employed is to use scaling and impedance compensation to obtain the control of the sensitivity. The method evolved permits the realization of grounded, active RC networks, with specified real frequency variation. The attendant constraints resulting from realization by grounded, transformerless networks are developed. Applications to typical procedures and an evaluation based on sensitivity criteria are included. Author

N64-28607 General Electric Co., Irmo, S.C. Capacitor Dept.
SOLID ELECTROLYTE TANTALUM FOIL CAPACITOR Quarterly Research and Development Report, 28 Mar.–28 Jun. 1964
A. L. Jenny [1964] 38 p
(Contract NObr-89380)
(AD-603305)

The status of the current program is as follows: (1) A statistically designed experiment containing symmetry, both in regard to temperature and time, has been completed for establishing vacuum annealing conditions on etched foil. An evaluation of the experimental results and the selection of the annealing conditions resulted in a compromise of finished capacitor characteristics and the physical conditions of the etched foil. (2) A semiaqueous electrolyte consisting of 50 parts by volume of ethylene glycol, 50 parts by volume of distilled water, and H_3PO_4 in sufficient quantity to provide a solution resistivity of 2,500 ohm/cm at 100° C was used in preparing capacitance prototypes rated 150 v and 200 v at 85° C (3) An experiment designed to determine the proper $Mn(NO_3)_2$ solution for pyrolysis and the best reformation electrolyte, as well as the process temperature of each, has been completed on plain annealed foil samples. The results from this experiment have been used in establishing the process for the required contract samples of the plain 150-v design. (4) An aging experiment was completed to study the voltage capabilities of large capacitance samples during the 85° C aging process. In addition, weld-area problems are discussed. I.v.L.

N64-28614 Utah U., Salt Lake City Microwave Devices Lab.
TRAVELING-WAVE TUBES WITH NONPERIODIC DIELECTRIC CIRCUITS
Carl H. Durney and Richard W. Grow 1 May 1964 80 p refs
(Contract Nonr-1288(05))
(ONR-7; AD-601790)

Dielectric circuits, which in the past were considered to be unsatisfactory for use as slow-wave circuits in traveling-wave interaction, are analyzed from the traveling-wave approach. Using field techniques, the field and power propagation characteristics of the circuits were found. The interaction impedance was calculated and averaged to allow for the variation of the electric fields over the region of the electron beam. The gain of the dielectric-circuit traveling-wave tube is calculated and gain characteristics are shown. Essentially four dielectric circuits are treated. Two circuits, a dielectric-coated conductor in a waveguide and an inhomogeneously dielectric-loaded rectangular waveguide, have reasonable gain at X-band, but are very lossy at millimeter wavelengths. The other two circuits, a dielectric tube in a round waveguide and a dielectric plate between two semi-infinite conducting planes, have reasonable gain at 300 Gc. All four circuits are narrow band and require the electron beam to be very close to the dielectric. Author

N64-28618 Westinghouse Electric Corp., Pittsburgh, Pa.
MINIATURE NEUTRON DETECTOR DEVELOPMENT Quarterly Progress Report, Oct. 1–Dec. 31, 1963
J. Weisman, ed. 16 Jan. 1964 21 p
(Contract AT(30-1)-2827)
(WCAP-2562)

The development of miniature neutron detectors continued along two main lines, i.e., development of improved junction structures and fabrication procedures, and development of diode configuration for very high temperature operation. To aid in the former objective, several diodes were studied using a scanning electron microscope. The procedure allows the junction structure to be studied in detail and allows a greater understanding of diode properties. Work on the development of diode configurations for very high temperature operation is proceeding. Bonding to platinum appears encouraging. Bonds to tungsten, with or without an intermediate layer of platinum, have not withstood thermal cycling. A new test assembly for evaluation of diode counting properties was built and put into operation. It is planned to use this equipment for high temperture annealing studies after a suitable diode configuration is developed. Author

N64-28620 Bliley Electric Co., Erie, Pa.
PRODUCTION ENGINEERING MEASURE: CR-(XM-45)/U QUARTZ CRYSTAL UNITS Quarterly Progress Report, 1 Sep.–1 Dec. 1963
J. M. Wolfskill, A. R. Krespan, and Robert Mouck [1963] 28 p
(Contract DA-36-039-SC-86719)
(QPR-6; AD-601920)

The CR-(XM-45)/U crystals are ruggedized units in the 90- to 200-kc frequency range. The original requirements were that these units have much more stringent temperature-frequency stability than the standard CR-42A units of specification MIL-C-3098, and that they have the ability to take 10- to 2,000-cps, 15 vibration. It proved to be impossible to meet the original requirements; the ruggedized CR-(XM-45)/U units could not attain tighter temperature-frequency stability than the ±0.002% demanded of the nonruggedized CR-42's. Investigation was made to determine realistic requirements that could be met by units able to meet the new vibration requirement. The rugged units could be made to meet the same performance levels as the nonrugged (CR-42A/U) units, provided an additional 3.5-pf capacitance were permitted and a maximum resistance value of 7,500 ohms were allowed. Author

N64-28626 Microwave Associates, Inc., Burlington, Mass.
HIGH POWER BEAM-PLASMA AMPLIFIER Fifth Quarterly Progress Report, 15 Dec. 1963–14 Mar. 1964
M. A. Allen, C. S. Biechler, P. Chorney, and H. S. Maddix 10 May 1962 65 p refs
(Contract DA-36-039-AMC-00076(E); ARPA Order 331-62; Proj. Defender)
(Rept.-5; AD-602253)

Efficiency predictions obtained from the large signal computer theory are given. A Langmuir probe plasma mapping vehicle is described and results are given. A coupling experiment showing 20 db of coupling enhancement due to the plasma is discussed, and the design of a second amplifier tube is presented. Author

N64-28629 European Atomic Energy Community, Brussels (Belgium)
TUNNELDIODES AS MULTIVIBRATOR FOR FAST COUNTING IN TIME-OF-FLIGHT CODING AND DERANDOMISING APPLICATIONS
H. Meyer and H. Verelst Joint Nucl. Res. Center, Geel Estab., May 1964 17 p refs
(EUR-528.e) Available from Belgian Am. Bank and Trust Co., N.Y., Account no. 121.86: 40 Belg. Fr.

In time-of-flight coding devices for the moment under development, scalers with high double-pulse resolution, small propagation delay, and especially small delay jitter are necessary. The application of tunnel diode multivibrators to build up such fast scalers is considered. A simplified circuit theory is proposed and applied to practical circuit design. A 10-stage scaler was built with a maximum rate greater than 300 mc/s. With tunnel diode univibrators as coupling elements between stages, the propagation delay is about 16 mμs with less than 5% jitter. The use of such stages as pulse derandomizers is considered. The best measured double-pulse resolution was 2 mμs, but with the pulses momentarily available from fast nuclear counters, limits are mostly given by trigger pulse shape. Author

N64-28662 Centre de Physique Electronique et Corpusculaire, Orsay (France)
RESEARCH ON NOISE IN CROSSED FIELD DEVICES Final Report
F. Diamand Mar. 1964 75 p refs
(Contract DA-91-591-EUC-2525)
(WR-1178; AD-602261)

The purpose of this program was to develop a cw TPOM to study noise and spurious oscillations, seeking especially to reduce the amplitude of these parasitic phenomena. Noise of a TPOM is essentially related to the gun. In a pulsed TPOM, operated with a low beam impedance of the order of 1 KΩ, noise is much higher than thermal noise, by a factor that may reach 10^3 to 10^4. On the other hand, B. Epzstein and J. Arnaud have shown by gun studies, that for large beam impedances, involved in cw operation, this abnormal noise may be suppressed, by chosing a cathode that is narrow compared to the height of the beam cycloid. Further, Anderson, Mantena, and Van Duzer obtained noise figures comparable to those of a conventional O tube, using a space charge gun in a backward wave M amplifier, applied power was very low, of the order of 10 w. Author

N64-28663 Tung-Sol Electric, Inc., Livingston, N.J. Chatham Electronics Div.
PRODUCTION ENGINEERING MEASURE FOR TYPE 7890 SUPER POWER HYDROGEN THYRATRON Eighth Quarterly Progress Report, 8 Dec. 1963–7 Mar. 1964
[1964] 25 p
(Contract DA-36-039-SC-85984)
(Rept.-8; AD-602284)

Work was completed on one tube started during the previous report period and on three tubes assembled during the present period. One further tube is in process. Of these tubes, one was accidentally damaged, and two were lost by reservoir heater failures. One tube was satisfactory and successfully completed the Operation (2) life test. There are indications that the tubes can be further improved with additional grid cooling. Author

N64-28673 Autonetics, Anaheim, Calif. Research, Engineering and Reliability Div.
JOINING CONCEPTS FOR MICROELECTRONIC SYSTEMS
J. W. Slemmons and J. R. Howell Apr. 1964 72 p refs Presented to the Ann. Conf. of Engrs., Ohio State U., Columbus, 1 May 1964

Eight joining techniques being used to intraconnect–interconnect complex microelectronic systems are discussed: soldering, cross-wire welding, series (parallel-gap) welding, electron-beam welding, laser welding, thermocompression bonding, and series (microgap) bonding. The respective merits of each technique are mentioned, along with the importance of nondestructive testing methods in obtaining space-age reliability requirements. P.V.E.

N64-28680 General Electric Co., Pittsfield, Mass. Defense Electronics Div.
NUCLEAR RADIATION TOLERANCE OF TIMM
J. Hannabach and D. D. Mickey [1964] 40 p refs Presented at the Natl. Winter Conv. on Mil. Electron., Los Angeles, Calif., 6 Feb. 1964

The TIMM (Thermionic Integrated Micro-Modules) materials, components, and circuits were exposed to steady-state and transient nuclear-radiation environments. The facilities employed included steady-state reactors, pulsed reactors, linear accelerators, and flash X-ray machines. The experimental results are summarized. They indicate that there is little or no question that the TIMM concept is capable of tolerating high levels of steady-state nuclear radiation. The evidence with respect to the transient radiation problem is not quite so clear cut. However, successful transient tests were performed on TIMM at levels as high as an equivalent field of 10^9 R/sec. This was a mixed field of high-energy secondary electrons and bremsshalung X-rays. Encouraging results were also reported from such sources as Triga and Godiva (pulsed reactors) tests. R.T.K.

N64-28740 American Electronic Labs., Inc., Colmar, Pa.
DESIGN AND DEVELOPMENT OF SEMICONDUCTOR TEST SET, HN/USM-171 Third Quarterly Report, 1 Jan.–31 Mar. 1964
W. R. Orloff and T. J. Ryan [1964] 24 p
(Contract DA-36-039-AMC-03242(E))
(Rept.-3; AD-601994)

The AN/USM-171 study and design plan phase delineated the feasibility of the approach for the beta measurement and automatic lead selector. The major unknown was in-circuit leakage measurement. A significant breakthrough in measurement techniques for extracting the minute leakage current from the massive in-circuit shunt current was demonstrated. A 10:1 improvement in leakage measurement capability was achieved. An intensive design and breadboard verification test phase that concentrated on the emitter finding and low range leakage measurement circuits for the AN/USM-171 Test Set was accomplished. Final fabrication of the in-circuit probe using permanent tooling was accomplished, and a value engineering analysis was undertaken. Author

N64-28751* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PUT FETS TO WORK IN ELECTROMETERS
Robert Munoz Repr. from Electron. Design, 11 May 1964 5 p refs
(NASA-RP-281)

Field-effect transistors (FET) with their high impedance and low noise can measure low currents very effectively. One way of using an FET is to transform current being measured at the input by means of an operational amplifier and feedback resistor setup into a sizable voltage level at the output. The FET is used as the input stage for the operational amplifier. With this arrangement, currents as low as 10^{-13} amp can be

measured over a 1-cps bandwidth. To make thermal noise negligible and eliminate the only limitation to the system's sensitivity, the feedback resistor should be very large. A.W.

N64-28772 Stanford Research Inst., Menlo Park, Calif.
TUNNEL CATHODES FOR MICROWAVE TUBES
D. V. Geppert and B. V. Dore Wright-Patterson AFB, Ohio, ASD, Oct. 1963 141 p refs
(Contract AF 33(657)-8721)
(ASD-TDR-63-672; AD-415364)

This program consisted of a theoretical and experimental study of the electron emission into vacuum from metal-insulator-metal (M-I-M) sandwiches. Analyses are presented for the conduction mechanisms through thin insulating films, for the generation of hot electrons in M-I-M structures, for the transport of hot electrons through thin metal films, and for the emission into vacuum of hot electrons in metal. Details are presented of the work on various combinations of metals and insulators in experimental M-I-M cathodes. Author

N64-28775 Burroughs Corp., Paoli, Pa. Paoli Research Lab.
MAGNETIC PARAMETRON LOGIC ELEMENTS Fifth Quarterly Progress Report, 1 Apr.–30 Jun. 1964
S. N. Einhorn [1964] 28 p ref
(Contract DA-36-039-AMC-02252(E))
(Rept.-5; AD-445261)

The design of a sense amplifier for the RF memory was completed. A cascode configuration replaced common-emitter circuits. The preliminary design of the phase detector was completed. Tests of electroplated wire for parametron development showed that the beryllium–copper wire was inferior to tungsten wire for parametron development. Three-group excitation circuitry was designed. Several miscellaneous experiments were conducted as a part of an overall evaluation of parametrons and a determination of the frequency-power relationship. Comparative studies of the parametron version versus the NOR logic configuration of the hypothetical computer were made and showed that the NOR logic is superior in the considerations of cost and power while the parametron has a slight edge in reliability. Author

N64-28776 Joint Publications Research Service, Washington, D.C.
VIEWPOINTS ON THE DECREASING OF THE VOLUME OF DEVICES CONTAINING CLASSICAL COMPONENTS
K. Schlenzig 7 Nov. 1962 10 p refs Transl. into ENGLISH from Nachrichtentechnik (E. Berlin), vol. 12, no. 7, Jul. 1962 (JPRS-16075) OTS: $1.10

This paper deals with the continued need for using traditional components in electronic devices. Miniaturization is not always the most efficient or economical solution to producing long-life devices. Suggestions for determining the best approach, traditional or miniaturized, are given. G.D.B.

N64-28920* Aero Geo Astro Corp., Alexandria, Va. Radiation Div.
AN INVESTIGATION OF THE PERFORMANCE CHARACTERISTICS OF MINIATURE AND SUBMINIATURE CABLES AND CONNECTORS
K. D. Mc Donald, P. E. Schmid, R. F. Thompson, and P. F. Moffett May 1963 82 p refs
(Contract NAS5-2583)
(NASA-CR-56543) OTS: $8.10 ph

Results of an investigation to determine the optimum combinations of existing miniature and subminiature cables and connectors for the frequency range of 100 mc to approximately 3.0 gc and above are reported. The evaluation included the following characteristics: mismatch; attenuation; shielding; ease of assembly; performance of cable-connector system with multiple disconnects, reasonable flexure, and normal shock influences; and other anomalistic behavior important in practical systems. The semirigid, solid outer conductor coaxi-tube was found to have far less loss than flexible, braided outer conductor cables; therefore the Omni Spectra, Coaxi-Tube combination is definitely recommended. The screw-on connector assembly is favored over push-on or bayonet-type connectors. Two other combinations are also recommended and may be preferable for certain applications. M.P.G.

N64-28933* Gulton Industries, Inc., Hawthorne, Calif. Engineered Magnetics Div.
RESEARCH AND DEVELOPMENT STUDY ON DC TO DC CONVERTER ENGINEERED MAGNETICS MODEL EMCRL 131 Second Quarterly Report 1 Oct. 1963–1 Jan. 1964
L. Hemphill [1964] 21 p
(Contract NAS5-3470)
(NASA-CR-58243; Rept.-1386) OTS: $2.60 ph

This report covers the design of a highly efficient d.c. to d.c. converter with 59-w output consisting of 4 regulated, isolated, and short-circuit-protected outputs. Time was expended on optimizing the pulse width regulator. A preliminary design of the output series regulator and current limiting circuitry is nearing completion. Author

N64-28938* Wilmot Castle Co., Rochester, N.Y. Research Labs.
STUDIES FOR STERILIZATION OF SPACE PROBE COMPONENTS Progress Report No. 1, Sep. 1–Dec. 1, 1963
Martin G. Koesterer 1 Feb. 1964 12 p refs
(Contract NASw-879)
(NASA-CR-58286) OTS: $1.60 ph

Research activities reported include the following: (1) determination of the times required to sterilize carbon black, either with its natural contamination level or with spores added to it, by dry heat and by moist heat; and (2) determination of the heat resistance of microorganisms collected from the atmosphere. The results of the first study indicate that carbon black can be sterilized with dry heat (135° to 160° C) in times less than those required for soil samples at the same temperatures, and that microorganisms in carbon black can also be effectively sterilized with conventional moist-heat cycles. Preliminary results of the second study indicate that microorganisms collected on membrane filters from various areas could not survive 1 hr at 120° to 135° C. Some observations on sampling techniques are made, and further tests will be necessary, using filters or objects exposed for longer times to fallout from the atmosphere. M.P.G.

N64-28941* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
FLUID AMPLIFIER APPLICATION STUDIES: RESEARCH AND DEVELOPMENT-FLUID AMPLIFIERS AND LOGIC, PHASE II Summary Report
R. A. Raber and J. N. Shinn ed. 30 Apr. 1964 161 p
(Contract NAS8-5408)
(NASA-CR-58028) OTS: $12.00 ph

Work consisted of studies to determine which applications of fluid amplifiers would be advantageous to NASA. It has been concluded that the best applications for further study are (1) replacement of electronic amplifiers and networks of gas servos for engine actuation, and (2) a digital integrator

that forms the fundamental building block for nearly all digital computation and control. Advantages of using fluid amplifiers for these applications are primarily environmental tolerance and the potential of higher reliability. A brief comparison of fluid amplifier and electronic reliability is included. Author

N64-28951* Tennessee U., Knoxville
A NEW MEASURE OF POLE SENSITIVITY OF FEEDBACK SYSTEMS Scientific Report No. 5
J. C. Hung 30 Jun. 1964 31 p refs
(Grant NsG-351)
(NASA-CR-58239) OTS: $3.60 ph

The object of this paper is to review the various definitions of "sensitivity," and to propose the more satisfactory mathematical definitions of the "pole sensitivity of a feedback system" for engineering applications. A mathematical definition of pole sensitivity is proposed. The merits of these definitions and their practical reliability are demonstrated. Author

N64-28956* Martin Co., Baltimore, Md. RIAS Div.
STABILITY AND POSITIVE SUPERMARTINGALES
R. S. Bucy [1963] 8 p refs
(Contracts NASw-845; AF 49(638)-1206)
(NASA-CR-58576) OTS: $1.10 ph

The problem considered is the stability of solutions of nonlinear difference-equations containing random elements. Guided by the Liapunov theory for deterministic systems, the concepts of a random equilibrium point and stability of a random solution in probability as well as an almost-everywhere or almost-sure asymptotic stability are introduced. These concepts seem the natural counterparts for random systems of the Liaponov theory with positive supermartingales corresponding to Liapunov functions. Author

N64-28961 Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
PLANAR INTEGRATION OF THIN FILM UNITS First Quarterly Progress Report, 15 Jan.–14 Apr. 1964
M. Lauriente, C. A. Harper, J. M. Winter, and C. W. Wyble [1964] 50 p refs
(Contract DA-36-039-AMC-03732(E))
(Rept.-1; AD-442157)

Some of the thermal expansion requirements of the ideal bridging material can be relaxed by a material that flows plastically. From a geometrical viewpoint, the ratio of hole depth to width should be as small as possible. All candidate materials could be applied by screening. Adhesion of conductors deposited over them was satisfactory. Organics were compatible with all permutations of chip and substrates specified, but inorganic bridging materials would only work with the Corning 0211 substrate because this combination more closely approached the ideal thermal expansion requirements. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-27916 Sylvania Electric Products, Inc., Williamsville, N.Y.
DETAILED TEST REQUIREMENTS FOR WS-133B MINUTEMAN MAINTENANCE GROUND EQUIPMENT FIGURE A 14217 TEST SET, ELECTRICAL POWER AN/GSM-121. EVALUATION TEST PROGRAM
30 Apr. 1964 62 p
(Contract AF 04(694)-261)
(Rept.-00-264997; AD-601036)

Testing and equipment are discussed in terms of electrical-test requirements; test methods; failure reporting; vibration, shock, and climatic tests; and final operational-performance tests. G.D.B.

N64-28010* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PREDICTED ACOUSTIC EFFECTS AT MSFC OF THE STATIC TEST FIRING OF ADVANCED SATURN S-IC
Richard N. Tedrick 15 Jul. 1964 29 p refs
(NASA-TM-X-53086) OTS: $2.60 ph

This report presented the overall and octave band sound-pressure-level spectra that were predicted to result from the static test firing of the S-IC stage booster for the Saturn V vehicle. Acoustic hazard and damage criteria are discussed and applied to the predicted sound-pressure levels for the S-IC. The effects of the acoustic directivity and test stand orientation are explained. The overall acoustic implications of static testing the S-IC are discussed in terms of their effects upon surrounding installations and communities. Author

N64-28042 Joint Publications Research Service, Washington, D.C.
DESIGN AND APPLICATION OF THE ACOUSTICS LABORATORY
Ma Ta-yu *In its* Transl. on Communist China's Sci. and Technol. no. 100 30 Jul. 1964 p 1–22 refs (See N64-28041 20-07) OTS: $3.00

In acoustics research work, to obtain the diffuse sound field, free sound field, or other specific acoustical environments required for advanced experimentation, it is necessary to possess a highly specialized acoustics laboratory. The purpose of this article is to describe the highlights and the operational characteristics of the acoustics laboratory of the Chinese Academy of Sciences' Institute of Acoustics. A summary is presented of the scientific problems encountered in the design of the acoustics laboratory's reverberation chamber, soundproof chamber, and anechoic sound chamber, and the methods used to find solutions to those problems. The design of the acoustics laboratory was begun in 1956. Few modifications or changes were were made during the design phase of the acoustics laboratory; the construction-phase of the plan occupied a relatively long time, and several problems encountered in the initial design period still have not been resolved. Author

N64-28059* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PILOTED MOTION SIMULATOR INVESTIGATION OF VTOL HEIGHT-CONTROL REQUIREMENTS
Ronald M. Gerdes Washington, NASA, Aug. 1964 19 p refs
(NASA-TN-D-2451) OTS: $0.50

A moving-cockpit piloted simulator was used to investigate VTOL aircraft height control requirements during hover. Pilot opinion ratings were used to determine the relationships of control power, damping, and time constant in realistic VTOL hovering tasks. The minimum upward acceleration for "normal operation" was found to be 1.06 g, and minimum acceptable safe operation was determined to be between 1.02 and 1.03 g.

Minimum damping levels for normal operation were dependent on control system time constant when operating with high thrust-to-weight ratios. Acceptable control of altitude could be maintained in the event of artificial vertical damper failure as long as the control system time constant remained below 0.37 sec. Minimum acceptable control power was found to depend on the vertical velocity response during lift-off and touchdown maneuvers. Hovering steadiness tests with zero velocity damping indicated a tendency to overcontrol at time constants above 0.6 sec while the pilot's full attention was required at 1.2 sec. The relative importance of cockpit motion and visual display in correlating simulator and flight data was briefly investigated. Author

N64-28108 Weather Bureau, Washington, D.C. Instrumental Engineering Div.
WEATHER BUREAU AUTOMATIC PICTURE TRANSMISSION GROUND STATION ENGINEERING MODEL NO. 1
Robert R. Miller May 1964 28 p
(Rept.-6)

An engineering model of a meteorological satellite readout station providing real-time pictures of earth cloud-cover is described. General descriptions of both operational requirements and equipment are given with reference to pictorial diagrams. Operational evaluation indicates that the design approach is practicable. Author

N64-28140 Rice U., Houston, Tex.
CURRENT RESEARCH ACTIVITY IN SCIENCE, ENGINEERING AND MATHEMATICS
Jan. 1964 161 p refs

Current research activities in the following areas are discussed: (1) biology; (2) chemistry; (3) engineering—chemical, civil, electrical, and mechanical; (4) geology; (5) mathematics; (6) physics; and (7) space science. I.v.L.

N64-28163* College of William and Mary, Williamsburg, Va.
CONFERENCE ON HIGH ENERGY CYCLOTRON IMPROVEMENT
H. O. Funsten, ed. [1964] 381 p refs Conf. held at Williamsburg, Va., 6–8 Feb. 1964
(Grant NsG-567)
(NASA-CR-56934) OTS: $21.00 ph

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N64-28164* Brobeck (William M.) and Associates, Berkeley, Calif.
ENGINEERING DESIGN OF THE SPACE RADIATION EFFECTS LABORATORY
W. M. Brobeck *In* Coll. of William and Mary Conf. on High Energy Cyclotron Improvement [1964] p 300–305 (See N64-28163 20-10) OTS: $21.00
(Contract NAS1-1947)

The engineering design of the space-radiation-effects laboratory is reviewed. The CERN (600 Mev) design was chosen for the cyclotron. The electron acceleration requirements were met by the provision of two commercially available machines; for the range from 1/2 Mev to 3 Mev, a Dynamitron is provided. This is a d.c. machine using a voltage-multiplying circuit driven though capacity coupling from an RF supply at ground potential. For the range of 3 Mev to 10 Mev, a microwave linear accelerator is used. Proton beams must be transported a total of approximately 230 feet; electron beams must be transported approximately 90 feet. The proton transport system conducts protons to either of the two proton target areas. The system has an aperture of 8-in. diameter and includes a variable degrader as a permanent feature. The electron transport system permits the conduction of the beam from either electron accelerator to a target in the accelerator room and to the combined target area where the electron and proton beams can be brought into the same line. The building will be divided into three areas—the space-irradiation area, the neutron-meson area, and the experimental proton area (which is presently being planned). I.v.L.

N64-28165* Brobeck (William M.) and Associates, Berkeley, Calif.

THE USE OF MULTIPLE DEES IN THE FM CYCLOTRON

W. M. Brobeck *In* Coll. of William and Mary Conf. on High Energy Cyclotron Improvement [1964] p 306–310 (See N64-28163 20-10) OTS: $21.00

The possible advantages that encourage the investigation of the use of multiple dees are the possibility of an increase in the beam current proportional to the number of dees and the probability of eliminating the moving parts inherent in mechanical FM. Calculations were made for the RF power required with the use of 10 dees in a cyclotron of the CERN type. The Q was taken as 2.0 ($f/\Delta f$), where Δf is the frequency range of the dee. This was based on the relation $Q = 2.5\ (f/\Delta f)$, with an allowance for frequency overlap of the dees. The RF power was calculated as ω/Q times the energy stored in the dee capacities. The peak dee voltage was taken as 20 kv peak-to-ground. With the dees all on one side of the pole, the maximum RF power came out to be 3,300 kw. With alternate dees on opposite sides of the pole, the calculated peak power is 1,100 kw. The average power would be about half of the peak power. A reduction of dee voltage would, of course, reduce the power, but at the expense of loss in output. In general, it appears that a multiple dee system is a feasible method of increasing the output of a synchrocyclotron. I.v.L.

N64-28166* Brobeck (William M.) and Associates, Berkeley, Calif.

BEAM TRANSPORT SYSTEM FOR THE NASA 600 MEV SYNCHROCYCLOTRON

R. F. Nissen *In* Coll. of William and Mary Conf. on High Energy Cyclotron Improvement [1964] p 311–322 (See N64-28163 20-10) OTS: $21.00

(Contract NAS1-1947)

The proton beam-transport system will be handling primary proton beams with energies of 600 Mev and 300 Mev and degraded beams with energies as low as 20 Mev. This system has two identical branches. Just outside of the synchrocyclotron is a steering magnet that directs the beam down the beam tube. After the degrader, the beam is bent 45 degrees in order to eliminate particles and gamma rays originating in the degrader. The beam is monitored for cross-sectional shape and intensity at three points between the cyclotron and the target. The first point is just after leaving the cyclotron, the second is right before the degrader, and the last point is slightly ahead of the target. Finally, there are vertical and horizontal collimating slits a little way upstream from the targets. The beam optics are such that horizontal and vertical dimensions of the beam at the collimator correspond to the dimensions of the beam at the target. Since the collimator setting can be read and adjusted from the control room, the size of the beam spot on the target can be determined without monitoring the beam at the target. I.v.L.

N64-28167* Brobeck (William M.) and Associates, Berkeley, Calif.

THE DESIGN OF A 300 MEV EXTRACTION SYSTEM FOR THE NASA, SREL SYNCHROCYCLOTRON

J. R. Mulady *In* Coll. of William and Mary Conf. on High Energy Cyclotron Improvement [1964] p 323–336 (See N64-28163 20-10) OTS: $21.00

(Contract NAS1-1947)

Based on the analyses of several methods of obtaining reduced-energy beams, it appeared that the most feasible method of obtaining variable energy beams would be by a combination of the extraction of two primary beams, one of full energy and one of reduced energy from a reduced radius, and the degrading of these beams to the required intermediate energy. Toward this end, an extraction system was designed. The channel consists of 30 separate and individually adjustable sections. The first two sections also perform as the peeler. The regenerator is made up of two sections. Each section of the channel and regenerator is supported on its own adjustable base. These bases provide a radial adjustment of 1 1/2 inches, an azimuthal adjustment of 1/2 inch, and an angular adjustment of 8 degrees. The C-blocks, which support the channel walls, and the threaded rods on which the compensation bars are mounted provide an additional radial adjustment of 1/2 inch. The channel walls are made up of several thicknesses of iron plate so that the shielding can be easily adjusted by the removal or addition of iron in increments of 0.1 inch. The extraction system and the necessary flip targets, beam chopper, and beam clippers will be mounted on aluminum plates called platters. I.v.L.

N64-28204* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE FILTER-DIFFERENTIAL METHOD FOR SOLAR-SIMULATION SOURCES

In its Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 12 p (See N64-28201 20-23) OTS: $19.75 ph

A method is presented for rapid scanning of the spectrum of a source by transmitting the total spectrum through a color glass filter or a dielectric film filter and by measuring the energy by means of a total energy sensor (e.g., a thermopile). Three types of filters used in spectroscopic work are discussed—cutoff filters, bandpass filters, and neutral-density filters. Discussed also are some measurements made with color glass filters and with a thermopile to compare the spectral energy distribution of the following: a mercury–xenon arc without any intervening optical components; the same arc with the collimating module of a solar environment simulator; and a carbon arc with its condensing optical components. P.V.E.

N64-28209* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PRELIMINARY DESIGN ANALYSIS FOR AN ULTRAHIGH-VACUUM SYSTEM

J. E. A. John *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 6 p refs (See N64-28201 20-23) OTS: $19.75 ph

An analysis has been made to demonstrate the feasibility of using cryogenic pumping to obtain ultrahigh vacua. A chamber-within-chamber design was used to minimize real leak rates into the test chamber, the walls of the chambers being maintained at temperatures of 77°, 20°, and 4.2° K successively by means of cryogenic fluids. Estimates were made of ultimate pressures for such a system, with and without a test object in the inner chamber. Heat loads on the chamber walls were calculated, together with the resulting cryogenic-fluid flow rates required. As a cryogenic pumping system provides no facility for pumping noncondensable gases, it was suggested that a cryosorption panel be incorporated in the cryogenic pumping system, each system being complementary to the other. Author

N64-28238 Sperry Rand Corp., Gainesville, Fla. Sperry Electronic Tube Div.
SHAPED FIELD HOLLOW BEAM ELECTRON GUNS FOR INTERMEDIATE AND HIGH POWER TRAVELING WAVE TUBES Interim Engineering Report No. 1, 15 May–1 Aug. 1964
Wright-Patterson AFB, Ohio, Res. and Technol. Div., Aug. 1964 47 p refs
(Contract AF 33(615)-1501)
(NJ-2761-0173-1; AD-444754)

The basic principles and present state of the theory of shaped-field hollow-beam electron guns are described. A discussion is given of an experimental approach that will utilize a complex multisegment electron gun for empirical determination of optimum design parameters. The features and status of the experimental apparatus are discussed. Scaling laws applicable to shaped-field hollow-beam guns are derived and discussed. Author

N64-28307* Stanford Research Inst., Menlo Park, Calif.
RELATIVE OPERATING CAPABILITIES OF SELECTED ELECTRIC-ARC REENTRY ENVIRONMENT SIMULATORS
N. K. Hiester and C. F. Clark Washington, NASA, Sep. 1964 28 p refs
(Contract NASr-49(15))
(NASA-CR-99) OTS: $0.75

A technique is described for estimating the operating envelopes for supersonic electric arc air heaters. This involves utilization of a minimum amount of actual performance data plus determination of the upper and lower enthalpy, arc chamber pressure, and power input limits for the arc heater. The method of Winovich is then used to predict the enthalpy-arc chamber pressure envelope. Knowledge of the normal shock pressure recovery ratio from the nozzle area ratio, plus use of the laminar stagnation-point heating rate formula obtained from the Fay–Riddell analysis, permit conversion of this envelope to an enthalpy-heating rate envelope. Author

N64-28572 Aircraft Armaments, Inc., Cockeysville, Md.
ORGANIZATIONAL MODELS FOR COMMAND POST INFORMATION SYSTEMS Final Report
Bedford, Mass., ESD, Jun. 1964 49 p
(Contract AF 19(628)-2960)
(ESD-TDR-64-438; AD-603969)

This report attempts to clarify issues concerning the organization and functions of command post information systems (CPIS). The purpose of the report is to provide system designers with a better understanding of factors that influence the operation of a CPIS and that constrain system design alternatives. A CPIS is viewed as one of four systems making up a command post—the others being a command system, a weapon system, and a support system. The Air Force organization is discussed in the light of this concept, with special emphasis being placed on the relationship of the Air Force to the unified commands and the "L" systems. The insights gained from this analysis are incorporated into a conceptual model. This model provides the system designer with a conceptual framework for designing an integrated CPIS. An evaluation model, permitting the system designer to test certain design alternatives, was suggested as an extension of the conceptual model. Application of these models by a system designer will greatly facilitate the design of a CPIS. Author

N64-28712 Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
HYDRAULIC TENSION COMPRESSION FATIGUE MACHINE
Regis M. N. Pelloux and S. D. Brooks Jul. 1963 33 p refs
(DI-82-0268; AD-413095)

A tension–compression fatigue machine was designed and built, which permits fatigue testing under controlled uniaxial stress or strain amplitudes with zero, positive, or negative mean stress or strain. The stress or strain amplitudes can be varied continuously during a test in order to perform increasing stress or strain amplitude fatigue tests. Recording of the stress or strain levels and of the stress–strain hysteresis loops is done by means of an oscilloscope and/or an X-Y recorder. The hydraulic system, the instrumentation, and the command, control, and read-out electronic systems are described in detail. Some results that are representative of the applications of the fatigue machine are described. Author

N64-28759* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TRACKING AND DATA ACQUISITION FOR RANGER MISSIONS 1–5
N. A. Renzetti 1 Jul. 1964 276 p refs
(Contract NAS7-100)
(NASA-CR-58537; JPL-TM-33-174) OTS: $17.50 ph

This document summarizes the technical activities of the Deep Space Instrumentation Facility in support of missions 1 through 5 of the Ranger project. The narrative includes a synopsis of each mission, a comprehensive account of the tracking operations, and a performance evaluation. The tracking and data acquisition support provided by the Atlantic Missile Range sites and the Space Flight Operations Center at the Jet Propulsion Laboratory are delineated also. Author

N64-28862 Kitt Peak National Observatory, Tucson, Ariz.
MONTHLY REPORT: KITT PEAK, MAY 1964; CERRO TOLOLO, FEBRUARY, MARCH, APRIL, MAY 1964
1964 30 p refs
(Sponsored by NSF)

News notes from Kitt Peak National Observatory, Tucson, Arizona, and Cerro Tololo Inter-American Observatory, La Serena, Chile, include meetings with various corporations; settlement of claim regarding extra cost of 84-inch telescope; payrolls and personnel; instrument notes; libraries and their publications; Stellar Division, Solar Division, and Space Division reports; and the general progress at Cerro Tololo in construction and location of facilities. A.W.

N64-28908 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
FIRST OPERATIONAL YEAR OF THE RTA

J. T. Pancoast and E. L. Jordan 1 Feb. 1963 102 p refs
(Contract AF 33(657)-7201)
(NARF-62-14T; FZK-9-179; AD-409860)

The Reactivity Test Assembly (RTA), a heterogeneous, light water, unpressurized, fully enriched system that operates as a zero-power reactor, was used in Ground Test Reactor and Aerospace Systems Test Reactor experiments. Some of the GTR experiments described are rod calibration, void measurements, fission-plate reactivity contribution, and moderated-fast-section reactivity measurement. The ASTR experiments with RTA included rod calibration, core thermal-neutron flux measurements, and core critical experiment and loading adjustment. G.D.B.

N64-28909 Naval Ordnance Test Station, China Lake, Calif.
THE DESIGN OF THE RAIN EROSION TEST FACILITY AT THE SUPERSONIC NAVAL ORDNANCE RESEARCH TRACK
Gary K. Fisher Jul. 1963 18 p refs
(NOTS-TP-3232; AD-420698)

This report describes the design and development of a rain-erosion test facility at the Supersonic Naval Ordnance Research Track (SNORT). It covers the conditions to be expected during natural rainfall and progresses through the development of empirical nozzle equations to establish water drop size relative to nozzle pressure and orifice diameter, and includes a description of the end design of the rain erosion facility. Author

N64-28919* National Aeronautics and Space Administration, Washington, D.C.
NASA INSTALLATIONS
Sept. 1963 31 p GPO: $0.20

Brief descriptions of the various NASA facilities and installations throughout the country are presented. The responsibilities of and activities at the installation are also outlined. P.V.E.

N64-28927 Aerospace Industries Assn. of America, Inc., Washington, D.C.
CATALOG OF SPACE SIMULATION VACUUM CHAMBERS
Jun. 1964 81 p ref
(Sponsored by Northrop Corp.)
(ATC-ARTC-38) Available from Natl. Std. Assn., Inc., Wash., D.C.: $1.50

The primary purpose of this catalog is to list the national capability in the technological field of space simulation vacuum chambers. The guide lines used in obtaining the data contained in this document are noted to aid in interpreting the information. A list was compiled of known owners of space chambers. These are the basic guide lines for entry in the catalog: chambers larger or more sophisticated than conventional bell jars; chambers capable of pressures below 10^{-2} torr for very large chambers and approximately 10^{-4} torr for smaller chambers; chambers with special simulation capabilities such as UV and X-ray radiation; and chambers operational, under construction or committed in some way, such as being funded, although still in design. Author

N64-28998* ADCOM, Inc., Cambridge, Mass.
STUDY OF GODDARD RANGE AND RANGE RATE SYSTEM FOR THE ADVANCED TECHNOLOGICAL SATELLITE Second Quarterly Report, 1 Jan.–31 Mar. 1964
Elie J. Baghdady, Cesar A. Filippi, Edmond V. Kiatipov, and Kenneth W. Kruse [1964] 49 p refs
(Contract NAS5-3694)
(NASA-CR-60017) OTS: $4.60 ph

Several proposed methods of implementing coherent doppler range-rate measurements for the Advanced Technological Satellite are being analyzed. An adaptation of the Syncom Beacon Technique is used as a basic performance reference to which the following alternatives are compared: (1) use of an extra range-rate tone at 10 mc; (2) use of single 10-mc sideband in the same manner; and (3) use of the 500-kc range tone for also providing range rate. It is shown that additive noise does not prevent the attainment of 0.01 m/sec resolution for any of these techniques. A comparison of the tracking performance of second- and third-order phase-locked loops shows that these systems have equal errors for a constant doppler shift input if the loop gains are equal and no perfect integrators are allowed. The third-order loop is shown to have a smaller error for a constant doppler rate input. M.P.G.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-27905* Lockheed-California Co., Burbank
[NUMERICAL SOLUTIONS TO FLUID DYNAMICS PROBLEMS, PROGRAMMING OF THE SOLUTIONS; AND COMPUTER CHECKOUT OF THE PROGRAMS] Fourth Monthly Progress Report, 1–30 Sep. 1963
[1963] 9 p
(Contract NAS2-1460)
(NASA-CR-56414) OTS: $1.10 ph

Reported is progress in the assembly of the numerical solutions to the various fluid-dynamics problems, the programing of these solutions, and the checkout of the programs on the computer. G.D.B.

N64-27912* Lockheed-California Co., Burbank
[NUMERICAL PROCEDURES FOR PROGRAMMING THE INVISCID FLOW FIELD] Second Monthly Progress Report, 1 Jul.–31 Jul. 1963
John L. Benson [1963] 4 p refs
(Contract NAS2-1460)
(NASA-CR-56369) OTS: $1.10 ph

Various numerical procedures for solving the inviscid external and internal flow field by the method of characteristics were completed. The numerical procedures for the laminar and turbulent boundary-layer solutions were obtained. R.T.K.

N64-27951* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE STABILITY OF A LIQUID LAYER OF UNIFORM THICKNESS SPREAD OVER A RIGID CIRCULAR CYLINDER SUBJECTED TO LATERAL ACCELERATIONS
Richard M. Beam Washington, NASA, Aug. 1964 25 p refs
(NASA-TN-D-2450) OTS: $0.75

The equations of motion for a liquid layer of uniform thickness spread over a rigid circular cylinder subjected to lateral acceleration are derived. The liquid is assumed to be inviscid and incompressible, and the analysis is restricted to the linearized (small deflection) equations of motion. The effect of surface tension of the liquid is included. A modal solution

of the equations of motion is obtained, and the stability criterion for the liquid layer is derived. In addition, the criterion for maximum instability, or droplet formation, is derived. Both of these criteria are presented graphically as a plot of axial (along the axis of the cylinder) wavelength versus Bond number. Correlation between a previous approximate theory and the present theory is presented. The available experimental data are compared with the theories. Author

N64-27955 Naval Ordnance Lab., White Oak, Md.
VIBRATIONAL RELAXATION OF NITROGEN IN THE NOL HYPERSONIC TUNNEL NO. 4 Aerodynamics Research Report No. 209
E. L. Harris and Lorenzo M. Albacete Jul. 1964 38 p refs
(NOLTR-63-221; AD-601590)

The problem of vibrational relaxation of nitrogen in a hypersonic tunnel analyzed for supply conditions of 3,600° R, 3,960° R, 5,400° R, and pressures of 80 and 100 atmospheres. A comparison between equilibrium, relaxing, and frozen flows was made for flow in the nozzle and around a pitot probe placed in the flow. The results are plots of static pressure, static temperature, free stream velocity, and stagnation pressure ratio versus nozzle area ratio. The flow freezes at very short distances downstream of the throat. When plotted versus nozzle area ratio, the ratio of impact to stagnation pressure gives identical results in the relaxing and frozen flow cases. The authors recommend that frozen flow be used as a convenient and reasonably accurate assumption for determining the test section conditions in the hypersonic tunnel. Author

N64-27965 Toronto U. (Canada) Inst. for Aerospace Studies
FLOW OF LOW DENSITY AIR OVER A HEATED FLAT PLATE AT MACH NO. 0.5
S. A. Gordon Mar. 1964 186 p refs
(Sponsored by Defence Res. Board)
(UTIAS-92)

Investigations are reported that measured flow characteristics in the vicinity of the leading edge of a flat plate in a low density wind tunnel. Temperature and molecular speed ratio were determined above an adiabatic plate and one heated to 100° C and 200° C in a nominal Mach 0.5 flow of air. The boundary layer begins to form as much as 10 mean-free-paths ahead of the leading edge. While slip-flow and a temperature pump were present, near the leading edge their dependence on the flow parameters is not that predicted by the expressions usually assumed. The accommodation coefficients as conventionally defined are considerably lower than normally assumed. A description is given of the design of the pressure probes. A theoretical expression for flow near the leading edge of a flat plate is developed that appears to fit the data. Author

N64-27980 Joint Publications Research Service, Washington, D.C.
THE EFFECT OF HEAT EXCHANGE AND TURBULENT FLOW IN THE REGION OF MIXING ON CHARACTERISTICS OF BREAKDOWN ZONES
V. Ya. Neyland *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 39–49 refs (See N64-27976 20-23) OTS: $5.00

The case of a region of mixing with variable braking enthalpy is considered. Calculations are made for laminar and turbulent flows in this region. Geometric characteristics of front breakaway are calculated, as is the bottom pressure. I.v.L.

N64-27981 Joint Publications Research Service, Washington, D.C.
INTERACTION OF ATOMS WITH THE SURFACE OF A SOLID
A. I. Yerofeyev *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 50–63 refs (See N64-27976 20-23) OTS: $5.00

The interaction of atoms with a solid is considered within the framework of a mathematical model of individual collisions. The process is described as follows: a part of the particles, as a result of the collision with atoms of the solid, is reflected immediately in the gas phase. The probability of such a reflection is determined by the differential cross section of the collision of elastic spheres. The remaining part of the incident particles will undergo multiple collisions with atoms of the solid. Furthermore, for high energies of incident particles, their flight inside the lattice is possible. The contribution of this flight to the exchange of energy and momentum can also be determined within the framework of this model. It is possible to explain a number of features of the processes of atomization of metals, during their bombardment by different ions, with the use of this model. The same model forms the basis for an explanation of the effect of focusing during radiation damage in metals. Therefore, it is possible to use it for the calculation of the exchange of energy and momentum of a flow of fast particles ($v \geqslant 10^6$ cm/sec) from a solid. I.v.L.

N64-27985 Joint Publications Research Service, Washington, D.C.
EXACT SOLUTION OF A GAS DYNAMICS PROBLEM ABOUT THE MOTION OF A PISTON
M. D. Ustinov *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 97–102 refs (See N64-27976 20-23) OTS: $5.00

Formulas are presented that give a complete solution of the motion of a piston according to a law determined by equality. Also, a formula is given for the initial parameters of the gas in which the piston moves. I.v.L.

N64-27986 Joint Publications Research Service, Washington, D.C.
SOLUTION OF A PROBLEM CONCERNING THE OSCILLATIONS OF A FLUID IN A TANK BY THE METHOD OF PERTURBING THE SHAPE OF THE BOUNDARY
G. A. Shadrin *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 103–109 refs (See N64-27976 20-23) OTS: $5.00

A method is proposed for solving the problem of the natural oscillations of a fluid in an axially symmetric vessel, which can be described as a cylinder. It is assumed that the fluid is ideal and incompressible and that the flows are potential. I.v.L.

N64-28011* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF THE METHOD OF INTEGRAL RELATIONS TO SUPERSONIC NONEQUILIBRIUM FLOW PAST WEDGES AND CONES
Jerry C. South, Jr. Washington, NASA, Aug. 1964 33 p refs
(NASA-TR-R-205) OTS: $1.00

The method of integral relations is used to calculate supersonic nonequilibrium flow past wedges and circular cones at zero incidence. Vibrational relaxation in a pure diatomic gas is considered so that the results can be compared with existing calculations using the method of characteristics. The approach taken is similar to that followed previously in ideal-gas problems, except that the isentropic law cannot be used and the vibrational rate equation is included. The governing equations are converted to approximate systems of ordinary differential equations, which are solved as initial-value problems

on a high-speed digital computer. Alternate procedures are discussed that point out certain features of general importance. Numerical results are presented to illustrate the convergence and accuracy of the method in predicting the distributions of flow variables during the approach to equilibrium. The calculations are performed through the third approximation for the wedge and through the second approximation for the cone. Author

N64-28013 Aeronutronic, Newport Beach, Calif.
AN APPROXIMATE METHOD FOR CALCULATING THE FLOW FIELD OF A ROCKET EXHAUSTING INTO A VACUUM Engineering Analysis Technical Note No. 24
A. I. Karydas and H. T. Kato 15 Jun. 1964 29 p refs
(Contract AF 04(694)-23)
(U-2630; AD-601616)

An approximate method for determining the far field flow properties of a rocket exhausting into a vacuum is presented. The technique described is based on radial flow and assumes a density variation both along and normal to the jet centerline. The resulting jet flow field is compared with solutions by the method of characteristics and is shown to have good agreement. Example calculations are provided to demonstrate the present method. Author

N64-28015 Canadian Armament Research and Development Establishment, Valcartier Defense Research Board
ON THE DEVELOPMENT OF A METHOD FOR PREDICTING THE GASEOUS RADIATION CHARACTERISTICS OF BLUNT BODIES AT HYPERSONIC SPEEDS. PART III—ULTRAVIOLET EMISSION
D. Ellington and C. M. Sadowski Jul. 1964 60 p refs
(ARPA Order-133)
(CARDE-TR-504/64)

A method is presented for calculating nonequilibrium radiation from the O_2 Schumann–Runge and NO β and γ band systems, based on a postulated mechanism of excitation reactions. Excitation is assumed to occur by two paths, chemiluminescent excitation through atomic recombinations and energy transfer to the molecular emitter in inelastic collisions. De-excitation is assumed to proceed via three paths: collisional dissociative de-excitation, energy transfer to the collision partner in an inelastic collision, and spontaneous radiation from the excited molecule. Rate constants estimated on simple collisional theory are employed, together with known radiative lifetimes, to calculate ultraviolet radiation from the gaseous shock layer of blunt bodies traveling at hypersonic speeds, based on earlier flow-field computations. The results show reasonable agreement with data obtained experimentally in a hypersonic range. Author

N64-28026 Technische Hogeschool, Delft (Netherlands)
LINEARIZED THEORY OF TWO-DIMENSIONAL CAVITY FLOWS
Jan Albert Geurst (Ph.D. Thesis) [1961] 221 p refs
(Contract N62558-2269)
(AD-600144)

Included in this paper are discussions of symmetric wedge flow—the connection between linearized theory and nonlinear models; linearized theory of partially cavitating hydrofoils—comparison of theory and experiment; wall effects on a partially cavitating hydrofoil; some investigations of a linearized theory for unsteady cavity flows; and a supercavitating hydrofoil in unsteady motion. G.D.B.

N64-28028 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
CRYOGENIC PUMPING OF GASEOUS MIXTURES [POMPAGE CRYOGENIQUE DE MELANGES GAZEUX]
Charles Hohnloser 1964 17 p In FRENCH, ENGLISH Summary Presented at Premier Congr. Intern. des Tech. du Vide en Rech. Spatiale, Paris, 29 Jun.–3 Jul. 1964
(ONERA-TP-109(1964))

The mathematical determination of the pumping velocity of a condensable gas obtained with a cooled wall agrees fairly well with experimental results if a proper correction factor is introduced for each facility. In the usual case of a gaseous mixture, it is necessary to know if each gas behaves as if it were alone at its partial pressure, or if there is a selective effect preventing the application of the elementary theory to each of the components. Tests have been carried out with vacuum tanks provided with condensors of various shapes and with known mixtures of CO_2 and of butane; these tests seem to show a selective effect in favor of CO_2. Author

N64-28031 Aeronautical Research Council (Gt. Brit.)
DIFFRACTION OF OBLIQUE SHOCK WAVE
R. S. Srivasiava London, HMSO, 1962 9 p refs
(ARC-CP-612; previously issued as ARC-23424) HMSO: 1s 9d

Some problems of diffraction of oblique shock wave are considered in this paper. The region between the incident and reflected shock wave remains undisturbed after the shock configuration has crossed the corner. When the shock configuration has crossed the corner, Mach reflection takes place provided the relative uniform flow behind the reflected shock wave is supersonic. Author

N64-28057* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GENERAL SOLUTION OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER IN THE STAGNATION REGION OF BLUNT BODIES IN AXISYMMETRIC FLOW
Fred W. Matting Washington, NASA, Jul. 1964 180 p refs
(NASA-TN-D-2234) OTS: $3.00

Solutions are developed in terms of tabulated universal functions. The method is valid for any gas in equilibrium. Gas properties are represented as polynomials in powers of a dimensionless enthalpy, the coefficients of the polynomials being independent of the universal functions. Examples are shown demonstrating the use of the method, and comparisons are made with exact solutions. A tabulation of working formulas (for machine or hand computations) is given. Author

N64-28084* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECT OF COMPRESSIBILITY, ROTATION AND MAGNETIC FIELD ON THE DRAG ON A SPHERE OSCILLATING IN A CONDUCTING, VISCOUS MEDIUM
M. P. Singh May 1964 43 p refs
(NASA-TM-X-55051; X-640-64-143) OTS: $4.60 ph

This report derives and solves equations for determining the effects of the magnetic field, compressibility, coriolis forces, and the mutual interaction of these on the drag and other physical variables. In the derivation of these equations, two important assumptions are made: (1) The magnetic Reynolds number is a small parameter. (2) The magnetic pressure is comparable to dynamic pressure. I.v.L.

N64-28098 Tokyo U. (Japan) Aeronautical Research Inst.
QUASISIMILAR SOLUTIONS OF BLAST WAVES

Koichi Oshima Mar. 1964 20 p refs *Its* Rept. 386 (Vol. 29, No. 8)

The quasi-similarity theory, which is useful to predict the flow pattern of blast waves with moderate strength, is introduced, and detailed calculations are carried out. Based on these results, an approximate formula is presented by which structures and propagations of the blast waves are described analytically. The results are compared with other theoretical and experimental data, and the validity of this theory is discussed. Author

N64-28099 Tokyo U. (Japan) Aeronautical Research Inst.
BOUNDARY LAYER GROWTH ON A FLAT PLATE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD
Hidenori Hasimoto Mar. 1964 23 p refs *Its* Rept. 388 (Vol. 29, No. 10)

Incompressible viscous flow solutions are found for an electrically conducting fluid flow over an infinite flat plate moving impulsively in the presence of a transverse magnetic field. The equations are solved in the form of the Laplace transform under the boundary conditions, taking into account the thickness and the conductivity of the plate and neglecting displacement currents. The formulas for the skin friction of the plate include those calculated by Rossow as a special case of magnetic Prandtl number P_m zero, in the two limiting cases of relative conductivity of the fluid to the plate. Author

N64-28102 Tokyo U. (Japan) Aeronautical Research Inst.
CHEMICAL NONEQUILIBRIUM BOUNDARY LAYER BEHIND A MOVING SHOCK WAVE
Hiroki Honma and Hakuro Oguchi 390 (Vol. 29, No. 12)

An analysis is attempted for the boundary layer in a chemical nonequilibrium region behind a moving shock wave into diatomic gases. The rate of mass production of atoms is taken into account for the boundary layer, as well as for the external flow. By introducing an appropriate expression for the mass production rate of atoms, the approximate solution for the problem has been obtained. Actual calculations were worked out for the distributions of mass fraction of atoms, heat-transfer rate, and temperature rise along the wall. From the results it is found that the dissociative relaxation process for the gas of external flow is appreciably amplified in the relaxing behaviors of surface temperature rise as well as of heat-transfer rate. Such amplification of relaxation process at the wall depends strongly on the catalytic behavior of the surface material, and not strongly on the mass production rate of atoms within the boundary layer. Author

N64-28120 Colorado State U., Fort Collins
HYDRAULIC PROPERTIES OF POROUS MEDIA
R. H. Brooks and A. T. Corey Mar. 1964 35 p refs
(Partially sponsored by NSF)
(Hydrol Paper-3)

Following the Burdine approach, a theory is presented that develops the functional relationships among saturation, pressure difference, and the permeabilities of air and liquid in terms of hydraulic properties of partially saturated porous media. Procedures for determining these hydraulic properties from capillary pressure–desaturation curves are described. Air and liquid permeabilities as a function of saturation and capillary pressure are predicted from the experimentally determined hydraulic properties. The theory also describes the requirements for similitude between any two flow systems in porous media occupied by two immiscible fluid phases when the nonwetting phase is static and flow of the wetting phase is described by Darcy's law. The requirements for similitude are expressed in terms of the hydraulic properties of porous media. Author

N64-28153 Aberdeen Proving Ground, Md. Ballistic Research Labs.
SHOCK HUGONIOT FOR COMPOSITION B
V. M. Boyle, R. L. Jameson, and F. E. Allison May 1964 27 p refs
(BRL Rept.-1250; AD-444777)

Measurements have been made of the transition to detonation of shock initiated Composition B. A technique has been developed to infer the magnitude of the pressure and particle velocity in the explosive from observations of the shock velocities in the explosive and in a Plexiglas cover placed in contact with the explosive. The shock velocity in the unreacted explosive is shown to be related to the particle velocity by the linear relation $U_1 = 2.88 \times 10^5 + 1.60u_1$ (cm per sec). It is also shown that the rate at which the pressure builds up increases with the distance the wave has propagated into the explosive. Author

N64-28156 Aberdeen Proving Ground, Md. Ballistic Research Labs.
ELECTRICAL CONDUCTIVITY OF WATER UNDER SHOCK COMPRESSION
Richard E. Yuknavech Mar. 1964 20 p refs
(BRL Memo.-1563; AD-444793)

The electrical conductivity of water under shock compression was measured from 40 to 194 kilobars. Measurements were made on a 0.051 cm × 0.254 cm × 0.762 cm volume of water contained in a polyethylene conductivity cell. The results are in agreement with those of David and Hamann; and Brish, Tarasov, and Tsukerman who used a different technique. The conductivity can be represented by the equation,

$$\sigma = 133 \exp(-5.52 \times 10^3/T),$$

where σ is the conductivity in ohm^{-1} cm^{-1} and T is the shock temperature in degrees Kelvin as calculated for water by Rice and Walsh. Author

N64-28176 Advisory Group for Aeronautical Research and Development, Paris (France)
COMBUSTION AND PROPULSION
R. P. Hagerty, A. L. Jaumotte, O. Lutz, and S. S. Penner, ed. Oxford, N.Y., Pergamon, 1963 686 p refs Papers Presented at the 5th Colloq. of the AGARD Combust. and Propulsion Panel on High-Temp. Phenomena, Braunschweig, 9–13 Apr. 1962 Pergamon: £7

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N64-28183 California Inst. of Tech., Pasadena Karman Lab. of Fluid Mechanics and Jet Propulsion

DYNAMICS OF A GAS CONTAINING SMALL SOLID PARTICLES

Frank E. Marble *In* AGARD Combust. and Propulsion 1963 p 175–215 refs (See N64-28176 20-11) Pergamon: £7

For gas–particle flow systems, the particle flow field and the mutual interaction of gas with the particle cloud are governed by four similarity parameters, each of which has a simple physical significance: (1) the velocity equilibration parameter, k_v/L—the ratio of the distance required for particle velocity to reach that of the fluid, to the characteristic geometric length of the flow field. (2) the thermal equilibration parameter, λ_T/L—the ratio of distance required for particle temperature to reach that of the fluid, to the characteristic geometric length of the flow field; (3) the momentum interaction parameter, κ—the ratio of particle mass density to fluid mass density, which governs the relative acceleration experienced by fluid and particle cloud as a result of interaction; and (4) the thermal interaction parameter, $\kappa(C_s/C_p)$—the ratio of thermal capacity of solid phase with that of the gas, which is a measure of relative temperature changes during equilibration. General equations for gas–particle flow systems are derived on the basis of a particle distribution function. When the problem involves particles of only one size, these relations simplify accordingly. Author

N64-28185 Technische Hochschule Munchen (W. Germany) Elektrophysikalisches Inst.

EXPERIMENTAL AND THEORETICAL STUDIES OF THE PROPERTIES OF NITROGEN AND AIR AT HIGH TEMPERATURES

H. Maecker *In* AGARD Combust. and Propulsion 1963 p 249–267 refs (See N64-28176 20-11) Pergamon: £7

A theoretical discussion of recent developments of the dynamics of reacting gases (dissociation and ionization) yields phenomenological equations containing transport coefficients, i.e., the coefficients of diffusion, electrical conductivity, heat conductivity, and viscosity. The cylindrical cascade arc with a power input of 10 kw/cm arc length has proven useful for the measurement of some of these transport properties. In N_2, temperatures of 16,000° K and an 80% degree of ionization are achieved. It is possible to determine the transport coefficients and the corresponding cross sections from spectroscopic measurement of the radial temperature distribution. The viscosity was determined by Wienecke in the flow field of the high-current carbon arc. In gas mixtures, separation of the various components occurs. This effect renders considerable difficulty for calculations and measurements. Author

N64-28186 Brussels U. (Belgium)

FORMULATION OF HYDRODYNAMIC EQUATIONS OF IONIZED GASES [FORMULATION DES EQUATIONS DE L'HYDRODYNAMIQUE DES GAZ IONISES]

P. Glansdorff *In* AGARD Combust. and Propulsion 1963 p 269–289 refs In FRENCH (See N64-28176 20-11 Pergamon: £7

This report distinguishes between the transport properties in gas mixtures that have strong interspecies interaction and those that have weak interspecies interaction. The first case correponds to the ordinary diffusion theory and the second to the two-fluid model. A formalistic representation of the hydrodynamic equations, as obtained from the equation for the singlet distribution function, is made. The singlet distribution function that yields the classical Navier–Stokes equation is assumed to be the solution of the kinetic equation for a plasma. A formal expression for the conductivity in terms of the diffusion coefficient, in a fashion similar to that used by Chapman and Cowling, is derived. In addition, the dynamical equations of a two-component gas are derived, assuming weak coupling between the gases, and this formulation is compared to the conventional theory as given by Chapman and Cowling. I.v.L.

N64-28187 Avco-Everett Research Lab., Everett, Mass.
PLASMA BOUNDARY LAYERS
James A. Fay *In* AGARD Combust. and Propulsion 1963 p 291–313 refs (See N64-28176 20-11) Pergamon: £7
(Contract AF 49(638)-659)

A review is given of recent work on boundary layers in electrically conducting fluids. This includes a discussion of the differences between ordinary boundary layers and plasma boundary layers, with special reference to the new dimensionless parameters for the magnetic case, including those that arise from the microscopic structure of the fluid. The convection of current and vorticity along magnetic field lines by the Alfvén wave mechanism is shown to be the principal new propagation mechanism in magnetohydrodynamic boundary layers. Recent work in inertial boundary layers, channel flows, wakes, and electrode boundary layers is summarized. Author

N64-28190 Farbenfabriken Bayer, A. G., Leverkusen (W Germany)
THE RHEOLOGY OF SUSPENSIONS
W. Meskat *In* AGARD Combust. and Propulsion 1963 p 457–482 refs (See N64-28176 20-11) Pergamon: £7

Starting from the mechanics of continua, the rheological equation of state is explained and the symbolic representation of various rheological models is discussed. The limits of this approach are shown, and the general principles of macrorheology are indicated. The solution of boundary-value problems of laminar flow is dealt with, because the measuring methods of rheology are based on this laminar flow. The effects occurring in the various suspensions are explained, and the process engineering conclusions are drawn. The behavior of suspended particles in the flow field is illustrated. Starting from microrheology, the viscosity–concentration equations of diluted and concentrated suspensions are discussed, the flow curves of technical suspensions are plotted, and the behavior of these suspensions under the influence of various stresses during production and processing is explained. Author

N64-28235* Pennsylvania State U., University Park Ordnance Research Lab.
EXPERIMENTAL INVESTIGATIONS OF INCIPIENT AND DESINENT CAVITATION
A. F. Lehman and J. O. Young Repr. from J. Basic Eng., Jun. 1964 10 p refs Presented at the Aviation and Space, Hydraulic, and Gas Turbine Conf., and Products Show, ASME, Los Angeles, 3–7 Mar. 1963
(Grant NsG-85/39-09-001)
(ASME Paper-63-AHGT-20)

Experiments with water in a high-speed recirculating water tunnel were undertaken to measure the pressures at which incipient and desinent cavitation occurred. Incipient cavitation is defined as the onset of cavitation; desinent cavitation is defined as the cessation of cavitation. The two lucite test sections used formed the minimum area region of the nozzle in the water tunnel. One test section had a smoothly changing internal contour, and the other had an abrupt contour change at the entrance to the cylindrical throat region. Cavitation in the abrupt contour occurred at the throat entrance at higher pressures than the cavitation pressures in the smooth contour. The cavitation in the smooth contour occurred at the entrance to the diffuser part of the nozzle. It was concluded that the cavitation pressures and cavitation numbers increased with velocity, the increase being greater for the abrupt contour with the exception of minimums indicated at incipient conditions in the abrupt contour at throat velocities near 88 fps. Author

N64-28246* Aeronautical Research Council (Gt. Brit.)
STREAMWISE EDGE EFFECTS IN THE TURBULENT BOUNDARY LAYER ON A FLAT PLATE OF FINITE ASPECT RATIO
E. B. Davies and A. D. Young (London U.) London, HMSO, 1964 32 p refs
(ARC-RM-3367, previously issued ARC-24596) HMSO: 12s 6d

A detailed investigation of the turbulent boundary layer on a flat plate of finite aspect ratio at zero incidence was made, incorporating measurements of mean velocity profiles and skin friction over one surface of the plate. Skin friction was measured using Preston's surface-tube technique with calibration, justified when compared with the measured momentum defect. These results are compared with others recorded on a two-dimensional plate (i.e., one that spanned the wind tunnel), and the effects of the streamwise edge on the boundary-layer flow on the plate surface are shown to be limited to regions of the plate surface near the edges of the order of a boundary-layer thickness in width. Author

N64-28326* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
BREAKUP OF A LIQUID JET IN A TRANSVERSE FLOW OF GAS
Bruce J. Clark Washington, NASA, Aug. 1964 48 p refs
(NASA-TN-D-2424) OTS: $1.25

The breakup of a water jet exposed to a flow of nitrogen at right angles to it was demonstrated by photographs and by measurement of its electrical resistance. The photographs show that the jet spreads progressively transverse to the flow of gas and that drops and ligaments tear off along the edges of the thinned-out jet. The electrical resistance of the jet increases as this breakup progresses and is a measure of the cross-sectional area of the portion of the jet remaining intact. As measured by the electrical resistance, the degree of liquid breakup is correlated graphically with the parameters influencing the breakup. Author

N64-28327* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF AIR INJECTION THROUGH A POROUS SURFACE AND THROUGH SLOTS ON TURBULENT SKIN FRICTION AT MACH 3
Donald I. Mc Ree, John B. Peterson, Jr., and Albert L. Braslow Washington, NASA, Aug. 1964 40 p refs
(NASA-TN-D-2427) OTS: $1.00

A preliminary investigation has been made at a free-stream Mach 3 and a free-stream Reynolds number per foot of 9.75 × 10^6 of the effectiveness of injection of air into the boundary layer through a porous surface and through single rearward-inclined slots in reducing the level of supersonic turbulent skin friction. Local and average skin-friction coefficients are presented for each injection configuration. The boundary-layer profiles are also shown and compared with the standard 1/7-power turbulent profile. A reduction in the average turbulent skin-friction coefficient of approximately 20% was obtained by distributed air injection through a porous surface. The most effective slot configuration investigated was the narrowest flush slot (0.018-in. wide), which provided a reduction in average skin-friction coefficient of 10% to 15%. All other slot configurations resulted in an increase in skin friction with increased injection rate. The effectiveness of the various slot configurations appears to be largely dependent on the manner in which the injected air mixes with the original boundary layer. Author

N64-28334* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STUDY OF CONTAMINATION-INDUCED LUMINOSITY AHEAD OF A BLUNT BODY IN THE LANGLEY HOTSHOT TUNNEL
William D. Harvey and William V. Feller Washington, NASA, Aug. 1964, 18 p refs
(NASA-TN-D-2449) OTS: $0.50

A spectrographic study of the contamination-induced luminosity behind a blunt-body shock wave in the Langley hotshot tunnel has been made. The study was conducted at a Mach 20 in nitrogen for a stagnation temperature of 3,000° K and a pressure of 12,000 psi. Both time-integrated and time-resolved spectra were obtained. Some of the species are identified. It was found that the occurrence of the luminosity was in short-duration bursts at variable times from shot to shot. Blackbody radiation was either absent or too weak to record. Author

N64-28341* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MASS ADDITION IN THE STAGNATION REGION FOR VELOCITY UP TO 50,000 FEET PER SECOND
John T. Howe and Yvonne S. Sheaffer Washington, NASA, Aug. 1964 54 p refs
(NASA-TR-R-207) OTS: $1.50

Solutions of the viscous shock-layer equations with mass addition were obtained. Flow-field equations include the effects of heat conduction, diffusion of reacting species, and emission and absorption of gaseous radiation for dissociated and partially ionized air in chemical equilibrium. Convective and radiative heating rates with mass addition are obtained from the solutions. Algebraic equations are derived for predicting the nose radius that minimizes total heating rates at a given flight speed and shock-layer pressure level. Values for the corresponding natural ablation rate, the effective heat of ablation, the ratio of radiative to convective heating rate, surface shear stress, and shock-wave standoff distance are given. The effects of ablated gases that radiate more strongly than air are examined. Rules for scaling flow-field structure with mass addition are discussed. Solutions without mass addition at low Reynolds numbers where external vorticity, energy depletion, and flow energy limiting are important are compared with existing theory and experiments. Author

N64-28415* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
BLADE-ELEMENT PERFORMANCE OF 0.7 HUB-TIP RADIUS RATIO AXIAL-FLOW-PUMP ROTOR WITH TIP DIFFUSION FACTOR OF 0.43
James E. Crouse and Donald M. Sandercock Washington, NASA, Sep. 1964 36 p refs
(NASA-TN-D-2481) OTS: $1.00

A 9-in.-diam axial-flow pump was tested in water. The double-circular-arc-bladed rotor had a hub-tip radius ratio of 0.7, tip solidity of 1.02, and design D-factors of 0.43 and 0.70 at the tip and hub, respectively. The investigation covered operations under both noncavitating and cavitating conditions. Radial surveys of flow conditions at the rotor inlet and outlet were taken, and performance across a selected number of blade elements was computed and presented. The largest variation of blade-element performance parameters with inlet flow occurred in the blade tip region, thus indicating the criticality of design in this area. Over the upper 30% of blade height, loss-coefficient distributions with incidence angles for this rotor configuration indicated that positive blade stall (sharp increase in loss coefficient) occurred very close to the minimum-loss incidence angle, but the loss coefficient increased very slowly moving from reference incidence angle toward a negative stall condition. Author

N64-28418 Applicazioni e Ricerche Scientifiche, Milano (Italy)
COMPUTATION OF THE FLOW BEHIND A CONVERGING DETONATION FRONT IN CYLINDRICAL OR SPHERICAL GEOMETRY
L. Guerri and A. Taroni (Joint Nucl. Res. Center, Ispra Estab., Italy) Brussels, Euratom, Jul. 1964 29 p refs
(Contract Euratom-009-62-07-FUAI)
(EUR-1848.e) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 50 Belg. Fr.

The report describes a finite difference scheme of implicit type for the computation of the gas flow behind a converging cylindrical or spherical detonation front together with the front trajectory. The scheme may also be applied to the plane case, which affords the possibility of a check with the known solution given by a simple rarefaction wave centered in the origin of the detonation. Author

N64-28419 Aeronautical Research Labs., Melbourne (Australia)
BOUNDARY LAYER MEASUREMENTS IN THE ARL HYPERSONIC TUNNEL CONICAL NOZZLE Aerodynamics Note 215
L. T. Banner and M. J. Williams Jul. 1963 17 p refs
(ARL/AERO-215)

Profiles of the various boundary-layer flow parameters were measured at the entrance of the test section of the hypersonic tunnel and found to be typically turbulent in form. The value of skin friction agrees well with other published data and also confirms the turbulent nature of the boundary layer. The displacement thickness compares favorably with other hypersonic facilities. However, the momentum thickness calculated by Spence's method is 20% lower than the measured value. Author

N64-28471 Joint Publications Research Service, Washington, D.C.
ON CALCULATION OF SUPERSONIC FLOW OF GAS OVER A THIN PLATE WITH A DETACHED SHOCK WAVE
A. P. Bazhin *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 31–39 refs (See N64-28469 20-01) OTS: $7.00

This article considers the problem of flow of gas over a thin plate with a detached shock wave. Apart from the independent significance, solution of the problem can yield an idea of flow directed at an angle to an axisymmetrical figure with angular points, such as a flat disk. The problem was solved by an approximation method for integral relations. The calculation results and their comparison with theoretical data are given. Author

N64-28472 Joint Publications Research Service, Washington, D.C.
APPLICATION OF DORODNITSIN'S REDUCTION METHOD FOR CALCULATION OF BOUNDARY LAYER OF AN AXISYMMETRICAL FIGURE ROTATING WITHIN AN AXIAL FLOW OF COMPRESSIBLE GAS
L. A. Dorfman *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 40–53 refs (See N64-28469 20-01) OTS: $7.00

The problem of the boundary layer of an axisymmetrical body rotating within an axial flow of compressible gas has been reduced by others to the solution of a system of differential equations of the boundary layer of an arbitrary flat flow of an incompressible liquid. The equations obtained are not, however, adapted to direct application of known approximate methods of calculating the boundary layer. The solution of this problem using Dorodnitsin's method is presented, as well as an example of the calculation method for half-body rotation. In addition, the application of Stewartson's method to Yamaga's approximate solution of the laminar boundary layer on a rotating body of revolution in uniform compressible flow is presented, and an example is given for the calculation of a rotating sphere. M.P.G.

N64-28473 Joint Publications Research Service, Washington, D.C.
LARGE AMPLITUDE OSCILLATIONS OF GAS WITHIN AN ENCLOSED DUCT
A. I. Gulyayev and V. M. Kusnetsov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 54–69 refs (See N64-28469 20-01) OTS: $7.00

Results of investigations show that the oscillatory condition with shock waves is associated with some interesting aspects that have not been noticed by previous authors. The existence of stationary eddies, turbulences, etc., was established, and changes in magnitude of instantaneous pressure rise and its distribution on the entire length of the duct were shown. The work further considers a nonuniform distribution of shock-wave energy losses along the length of the duct and temperature rises of the duct walls. Other energy losses are also analyzed. Author

N64-28474 Joint Publications Research Service, Washington, D.C.
NONLINEAR ACOUSTIC OSCILLATIONS OF GAS COLUMN WITHIN AN ENCLOSED DUCT
L. P. Gorkov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 70–78 refs (See N64-28469 20-01) OTS: $7.00

An analytical method giving a complete solution to the problem of minor nonlinear acoustic oscillations within an enclosed duct is presented for the case where the viscosity is relatively low and the amplitude of secondary oscillations is determined by the losses in the shock wave. The generated wave is considered as a weak one, and it is assumed that the oscillations are generated by a piston. Equations are obtained for the value of the shock wave intensity for changes in frequency within the resonance condition. These equations are not valid for cases where the viscosity and thermoconductivity of the gas are not negligible, since these conditions contribute to skin friction losses, which diminish the intensity of the shock wave. M.P.G.

N64-28475 Joint Publications Research Service, Washington, D.C.
ON LONGITUDINAL WAVE PROPAGATION IN ELASTIC POROUS MEDIA SATURATED WITH LIQUID
V. M. Nikolayevskiy *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 79–96 refs (See N64-28469 20-01) OTS: $7.00

This article offers the method of considering the compression of material in solid and liquid states. This allows evaluation of speeds of propagation and of damping of longitudinal waves within porous media. Porous media are capable of having two types of waves—the first type can be determined only through compression of the phase material in media with a weak internal structure, the other can be determined through rearrangement of solid particles of the medium. Author

N64-28476 Joint Publications Research Service, Washington, D.C.
FLOW PAST SPECIAL HYDRODYNAMIC FEATURES SITUATED OVER A BOUNDARY OF TWO FLUIDS OF DIFFERENT DENSITY
Ya. I. Voytkunskiy *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 97–113 refs (See N64-28469 20-01) OTS: $7.00

Results are presented of the solution of the problem of flow past the hydrodynamic features situated over the surface that determine the field of complex generated velocities of the eddy, source, and dipole. Expressions for hydrodynamic forces were indicated, and the limiting values of these forces for hydrodynamic forces for particular cases of motion were studied. Author

N64-28477 Joint Publications Research Service, Washington, D.C.
A DIRECT PROBLEM STRUCTURE OF TURBULENT COMPRESSIBLE FLUID FLOW IN GAS TURBINES
Ya. A. Sirotkin *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 114–130 refs (See N64-28469 20-01) OTS: $7.00

A direct relationship is established between the eddy system and equations of direct and reverse flow of turbulent compressible fluids in gas turbines. Equations are deduced for flows on surfaces S_1 and S_2 in layers of variable thickness, with direct consideration of tangential friction forces and heat exchange from the blade to the flow. It is shown that, under certain conditions, the flow surfaces of type S_1 and S_2 are also eddy surfaces satisfying coplanarity conditions. Boundary conditions are then selected for the flow on these surfaces in accordance with the accepted eddy pattern. This pattern permits the solution of three-dimensional flow in an elbow with arbitrary turbulence at the intake. The exposition is made primarily in a system of fixed coordinates, for convenience in computer calculation. M.P.G.

N64-28478 Joint Publications Research Service, Washington, D.C.
SUPPRESSION LIMITS OF DEFLAGRATION USING GRANULAR AND POROUS MATERIALS
V. F. Zakaznov, A. I. Rozlovskiy, and I. I. Strizhevskiy *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 131–145 refs (See N64-28469 20-01) OTS: $7.00

Critical flame-suppression conditions were analyzed for air and oxygen mixtures of CH_4, H_2, and C_2H_2 by means of steel ball and Rashig's rings settings of 2 to 14 mm; by means of multilayer filters made of bronze grids and glass cloth with

cells of 0.3 and 0.088 mm in size, respectively; and by means of plates made of porous metals—metal–ceramics with maximum pore diameters of 0.04 to 0.6 mm. Fire guards of metal ceramic plates and tubes are the most promising type. Author

N64-28487 Joint Publications Research Service, Washington, D.C.
ON BASE PRESSURE BEYOND THE WEDGE IN SUPERSONIC FLOW
Yu. G. Elikin, V. Ya. Neyland, and L. A. Sokolov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 287–295 refs (See N64-28469 20-01) OTS: $7.00

A solution is offered for the problem of a laminar mixture within semi-infinite supersonic flow or a gas at rest, filling a half-space, with consideration given to real physical properties of air. Also given are some results of calculation heat transfer for the transition zone of the laminary boundary layer. Author

N64-28489 Joint Publications Research Service, Washington, D.C.
SELF-MODELING MOTIONS OF AN IDEAL, PERFECT AND HEAT-CONDUCTIVE GAS
S. I. Fadeyev *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 300–311 refs (See N64-28469 20-01) OTS: $7.00

The motion and heat conductivity of a gas being expelled by a flat cylindrical or spherical piston are investigated. The gas is assumed to be ideal and perfectly conducting. P.V.E.

N64-28490 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF STRONG SHOCK WAVES WITHIN AN ELECTROMAGNETIC SHOCK TUBE
V. V. Zhurin, V. A. Sulyayev, and V. M. Bukovskiy *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 312–317 refs (See N64-28469 20-01) OTS: $7.00

Shock waves of a length of $5 \cdot 10^6$ to $8 \cdot 10^7$ cm/sec were created in oxygen and helium by means of discharge of gas under pressure, where the initial pressure was from $5 \cdot 10^{-2}$ to 1 mm of a column of mercury. Electron temperature of plasma following the shock wave was measured by the method of off-setting magnetic flux. Peculiarities of strong wave motion were studied by means of photoelectric recording of radiation and high-speed photography. Author

N64-28504* Israel Program for Scientific Translations, Ltd., Jerusalem
HYDRAULICS AND FUNDAMENTALS OF GAS DYNAMICS
A. M. Mkhitaryan 1964 238 p refs Transl. into ENGLISH of the book "Gidravlika i Osnovy Gazodinamiki" Kiev, Gosudarstvenn. Izd. Tekhn. Lit. Ukr. SSR, 1959 227 p
(Published for NASA and NSF)
(NASA-TT-F-146; OTS-64-11024) OTS: $2.50

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N64-28505 Princeton U., N.J.
A NEW NEGATIVE V'' STELLARATOR CORRUGATION FIELD
John L. Johnson Jun. 1964 5 p refs
(Contract AT(30-1)-1238)
(MATT-281)

Furth and Rosenbluth recently proposed a confinement scheme, with closed magnetic-field lines, that is hydromagnetically stable for low plasma pressure since $\oint dl/B$ has a local maximum. When a small rotational transform is present, this criterion is replaced by the condition $V''(\psi) < 0$. Here V is the volume of a magnetic surface, ψ the magnetic flux contained, and primes denote derivatives with respect to the argument. Lenard suggested two specific configurations that satisfy this condition. This note presents a different configuration in which small distortions of the magnetic surfaces achieve $V''(0) < 0$. Systems are considered where

$$\mathbf{B} = B^{(0)} \nabla \left\{ z + \gamma/h^2 \sum_{l=1}^{\infty} \delta_l (hr)^l \sin[l(\theta - \gamma z) + \phi_l] \right.$$

$$\left. + \sum_{p=1}^{\infty} \sum_{l=-\infty}^{\infty} \frac{\epsilon_{l,p}}{ph} I_l(phr) \sin[l(\theta - \gamma z) - phz + \phi_{l,p}] + \ldots \right\}$$

with $\gamma/h \sim \epsilon_{l,p} << 1$ and some $\delta_l \sim 1$. For finite γr, the coefficients of the sine functions must be altered slightly so that this potential satisfies Laplace's equation. The magnetic surfaces Ψ are defined such that $\mathbf{B} \cdot \nabla \Psi = 0$ and expand in a small parameter of the order $\epsilon_{l,p}$. In the zeroth order $\Psi^{(0)} = \Psi^{(0)}(r, \theta, \gamma z)$. In the configuration considered, the corrugation field can produce a small rotational transform of the field lines with respect to the twist of the magnetic surface. This could decrease the distance along the field lines between good and bad regions and reduce vulnerability to localized instabilities. I.v.L.

N64-28516 Iowa State U. of Science and Tech., Ames Ames Lab.
LIQUID-PHASE MASS TRANSFER AT LOW FLOW RATES IN A PACKED COLUMN
John Earnest Frandolig and R. W. Fahien Feb. 1964 126 p refs
(Contract W-7405-ENG-82)
(IS-817) OTS: $2.50

Liquid-phase mass transfer in a packed bed was investigated for flow conditions for which the effect of neglecting axial transfer in the prediction of concentration distributions would most likely be significant. The purpose of this study was two-fold—to obtain experimental concentration data suitable for comparison with future theoretical studies, and to analyze these data in terms of calculated effective axial and radial diffusivities and Peclet numbers. Author

N64-28525 David Taylor Model Basin, Washington, D.C. Aerodynamics Lab.
A METHOD FOR NUMERICAL CALCULATION OF SLIPSTREAM CONTRACTION OF A SHROUDED IMPULSE DISC IN THE STATIC CASE WITH APPLICATION TO OTHER AXISYMMETRIC POTENTIAL FLOW PROBLEMS

Harvey R. Chaplin (Ph.D. Thesis—Catholic U.) Jun. 1964 151 p
(DTM-1857; AERO-1077; AD-604127)

The problem of the axisymmetric flow of an ideal incompressible fluid through an impulse disc bounded by a thin shroud is considered. A systematic calculation procedure is developed, suitable for use on a large electronic digital computer. The shroud and slipstream are represented by a continuous surface distribution of ring vortices. The correct slipstream shape is approached by successive approximations. The results of calculations of the slipstream contraction ratio, in the static case, for cylindrical, conical, and parabolic-cambered shrouds, are presented. It is found that the slipstream contracts less severely, in the case of very short cylindrical shrouds, than had previously been supposed. Also for cylindrical shrouds, it is found that an excellent estimate of the slipstream contraction ratio can be obtained from a comparatively brief calculation, essentially equivalent to a calculation from the linearized theory, provided the estimate is based on the product of velocity and vortex density at the trailing edge rather than on the vortex density alone. Author

N64-28551 Polytechnic Inst. of Brooklyn, Freeport, N.Y.
TURBULENT TRANSPORT PROPERTIES FOR AXISYMMETRIC HETEROGENEOUS MIXING
Victor Zakkay, Egon Krause, and Stephen D. L. Woo Wright-Patterson AFB, Ohio, ARL, Jun. 1964 89 p refs
(Contract AF 33(616)-7661)
(ARL-64-103; AD-604008)

An experimental investigation of the turbulent mixing of two dissimilar gases for both subsonic and supersonic flows is presented. This investigation was carried out in order to determine the turbulent transport coefficients for hydrogen–, helium–, and argon–air mixtures in the mixing region of two coaxial jets. The basic differential equations describing the mean flow properties are solved for the transport coefficients. The convective derivatives that are needed in the solution of the equations are determined from the velocity and concentration profiles measured in the experiments. Values of the eddy viscosity, turbulent diffusion coefficient, and Lewis number were evaluated in this manner, and the eddy viscosity so obtained is then compared with existing formulations. The influence of similar velocity and concentration profiles on the transport properties is discussed, and similarity parameters in both axial and radial directions are shown to be valid for various injected gases. Author

N64-28559 California U., Berkeley Inst. of Engineering Research
CALCULATION OF SUPERSONIC FLOW PAST YAWED CONES BY THE METHOD OF INTEGRAL RELATIONS
M. Holt and S. C. Lee Mar. 1964 24 p refs
(Grants AF-AFOSR-268-64; NSF-GP-2103)
(AS-64-7; AD-603962)

The method of integral relations, as applied to the yawed cone problem by Chushkin and Shchennikov, is modified to take account of the entropy singularity on the leeward side of the cone. It is proposed to apply the method in two regions, in the quadrant adjacent to the singular generator and in the remaining quadrant including the cone surface and the shock. Results are not yet complete, but those obtained so far suggest that the modification will give a more realistic picture of the flow between the cone and the shock. Author

N64-28574 Ohio State U., Columbus Rocket Research Lab.
THE CONSTANT PRESSURE DECOMPOSITION OF NITROUS OXIDE, N_2O + .88N_2 AND N_2O + AIR MIXTURES AT 11.2 ATMOSPHERES AND INITIAL TEMPERATURES FROM 772° TO 1233°K
J. R. Nicholson, E. S. Fishburne, and R. Edse Wright-Patterson AFB, Ohio, ARL, Jun. 1964 44 p refs
(Contract AF 33(657)-8951)
(ARL-64-107; AD-603620) OTS: $1.25

The thermal decomposition of N_2O, N_2O + 0.88N_2, and N_2O + air has been investigated in a flowing system. These studies were conducted at 11.2 atmospheres over the temperature range from 772° to 1,233° K, and total flow rates from 1.0 to 3.76 liters/sec. Total residence times in the heated section range from approximately 0.1 to 2.5 sec. A maximum reacted gas temperature of 1,588° K was obtained. Chromatographic analysis of the products of decomposition showed that the maximum nitrogen dioxide yield was 4.44% for the N_2O + air mixture, 5.09% for the N_2O + 0.88N_2 mixture, and 7.55% for the pure N_2O decomposition. Spectrographic observations of the emitted radiation from the decomposition reactions showed the presence of nitrogen dioxide in the reaction. Nitrogen dioxide absorption bands were found. There was no evidence of any discrete bands in emission. A reaction rate constant of $4.15 \times 10^{10} \exp\{-51{,}000/RT\}$ was calculated for the decomposition of nitrous oxide in the N_2O + 0.88N_2 mixture. Author

N64-28598 Cincinnati U., Ohio
REFERENCE TEMPERATURE METHOD FOR COMPUTING DISPLACEMENT THICKNESS
M. Saarlas Wright-Patterson AFB, Ohio, ARL, Aug. 1964 37 p refs
(Contract AF 33(616)-8453)
(ARL-64-119; AD-604126) OTS: $1.00

Computation of the boundary-layer parameters with variable fluid properties is investigated. In particular calculation of boundary-layer displacement thickness is studied in the cases where the variation of the temperature across the boundary layer necessitates consideration also of variation of the specific heats inside the boundary layer. This problem is of considerable significance in computation of viscous interaction effects at high Mach numbers. Since exact computation of the displacement thickness, with variable fluid properties, is extremely cumbersome, an approximate method is given that permits evaluation of an effective specific heat and determines the displacement thickness in closed form. Author

N64-28642 Wigley (C.), London (Gt. Brit.)
FURTHER INVESTIGATION OF THE EFFECT OF THE FLUID VISCOSITY ON WAVE RESISTANCE USING A MODIFICATION OF LAURENTIEFF'S METHOD
C. Wigley May 1964 33 p refs
(Contract N62558-3642)
(AD-602217)

The modified Laurentieff method was applied to a model form that was not symmetrical fore and aft, and whose resistance in both directions of motion had been measured. The algebraic expressions for the resistance in either direction of motion in a viscous fluid were developed for this unsymmetrical form, and approximate integrations of these expressions were carried out so that the results for resistance differences could be compared directly with the measurements. A direct check is thus provided on the accuracy of Laurentieff's method of calculating the wave resistance in a viscous fluid. I.v.L

N64-28652* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MEASUREMENTS OF EFFLUX PATTERNS AND FLOW RATES FROM CYLINDRICAL TUBES IN FREE-MOLECULE AND SLIP FLOWS
Harlan Cook and Edward A. Richley Washington, NASA, Sep. 1964 39 p refs
(NASA-TN-D-2480) OTS: $1.00

Cesium vapor efflux patterns and flow rates from cylindrical tubes varying in length-to-diameter ratio from 0 to 4 were experimentally determined in the free-molecule, intermediate, and slip-flow regimes. Efflux patterns in the free-molecule-flow regime were in good agreement with theory, but flow rates fell somewhat below theory for larger length-to-diameter ratios. Efflux patterns in the slip-flow regime showed no noticeable dependency on the tube length. Flow rates in the intermediate and slip-flow regimes agreed fairly well with theory. With the cesium vapor used in this investigation, flux densities could readily be measured with a probe that employed the principle of contact ionization. The reliability of the probe was checked by obtaining the cosine distribution for free-molecule flow from a thin orifice. Author

N64-28694 International Union of Pure and Applied Chemistry, Basle (Switzerland) Commission on High Temperatures and Refractories
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS, NO. 12
L. Brewer, comp. (Calif. U., Berkeley) 30 Jun. 1964 26 p refs

N64-28769 Aeronautical Research Council (Gt. Brit.)
SOME NOTES ON TURBULENT BOUNDARY LAYERS WITH FLUID INJECTION AT HIGH SUPERSONIC SPEEDS
L. C. Squire London, HMSO, 1964 21 p refs
(ARC-CP-740; replaces RAE-TN-AERO-2904; ARC-25211) HMSO: 4s

Transpiration cooling has been suggested as a research topic for the high-supersonic-speed wind tunnel (M = 2.5 to 5.0). A brief review of existing work on this subject is given, and regions where more experimental work is needed are pointed out. Using existing data, an attempt is made to assess the importance of transpiration cooling for a long-range aircraft flying at high supersonic speeds. Author

N64-28804 Western Co. of North America, Dallas, Tex.
DRAG REDUCTION OF DILUTE POLYMER SOLUTIONS
H. R. Crawford and G. T. Pruitt [1963] 45 p refs Presented at the Symp. on Non-Newtonian Fluid Mech., 56th Ann. Meeting of the AIChE, Houston, Tex., 5 Dec. 1963
(Partially sponsored by Navy)

This paper presents the results of the first experiments demonstrating that a substantial drag reduction may be obtained, by the use of some polymer additives, on bodies moving through water. Data are presented on a model torpedo and on an outboard motorboat. A drag reduction of 82% was obtained on the model torpedo and approximately 10% on the boat. A rheogram (relation of shear stress to shear rate) is presented for two of these polymers that exhibit large drag reductions. Turbulent friction loss of some of these non-Newtonian solutions are presented. Capillary data are presented that show that some of these solutions are extremely elastic and that a fundamental understanding of the process might be obtained by an investigation of those elastic properties. Author

N64-28827 Army Natick Labs., Mass. Pioneering Research Div.
SOME EFFECTS OF JET-COMPRESSOR GEOMETRY ON EFFICIENCY: COMPRESSION-RATIO CURVES WITH TWO MAXIMA
Ronald A. Segars and Harold J. Hoge Jun. 1964 39 p refs
(PR-10; AD-602200)

Measurements were made with a new jet compressor of different geometry, and are compared with previous results. Efficiencies, compression ratios, and other data are presented for five systems of gases (He:Freon-113, He:CO_2, air:Freon-12, air:air, and Freon-12:air). Calculations of momentum-flux balance within the mixing tube have been made, and various results presented in a previous report were confirmed. Frictional losses in the mixing tube are shown for two different apparatuses, under several different operating conditions. The existence of two maxima in many of the curves of compression ratio versus outlet pressure is pointed out, and possible causes are discussed. A suggested cause of the second maximum is a rapid reduction of shock loss in the driving stream, as the acceleration of this stream to a relatively high supersonic velocity is suppressed. Author

N64-28831* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THEORY OF LIQUID SLOSHING IN COMPARTMENTED CYLINDRICAL TANKS DUE TO BENDING EXCITATION
Helmut F. Bauer 23 Jul. 1962 49 p refs
(NASA-TM-X-51944; MTP-AERO-62-61) OTS: $4.60 ph

Propellant sloshing may be established by the bending of a space vehicle that exhibits low structural frequencies. Forces and moments exerted by the oscillating propellant on the tank are determined due to forced bending excitation for a liquid in a circular cylindrical ring sector tank with a free fluid surface. Special cases such as the tank with sector and circular cross section are obtained by limit consideration. As is expected, force and moment of the liquid increase sharply at the resonant frequency of the propellant. The total force and moment are generally less for a given maximum bending amplitude than for a translational motion of the same magnitude. The maximum dynamic effects occur when the free fluid surface is located around the point of maximum bending displacement. Author

N64-28848 Aeronautical Research Council (Gt. Brit.)
THE EFFECT OF AN INITIAL BOUNDARY LAYER ON THE DEVELOPMENT OF A TURBULENT FREE SHEAR LAYER
J. F. Nash London, HMSO, 1963 29 p refs
(ARC-CP-682; replaces NPL-AERO-1019, ARC-23847) HMSO: 6s

The problem of predicting the mean velocity on streamlines through the preasymptotic turbulent-free shear layer in two-dimensional incompressible flow is resolved into two parts. The linearized momentum equation in terms of a generalized axial coordinate ζ_0 is solved in the usual way. A relation between ζ_0 and the distance from the separation point is then established analytically in contrast to the previous use of empirical expressions. Except in the region close to separation, the velocity on the streamlines can be predicted by the simple approximation proposed by Kirk. Author

N64-28885* Avco-Everett Research Lab., Everett, Mass.
NONEQUILIBRIUM SHOCK FRONT ROTATIONAL, VIBRATIONAL AND ELECTRONIC TEMPERATURE MEASUREMENTS
R. A. Allen Aug. 1964 27 p refs
(Contract NASw-748)
(NASA-CR-58673; Avco-Everett Res. Rept.-186) OTS: $2.60 ph

A spectroscopic technique is described for measuring nonequilibrium shock front rotational, vibrational, and electronic temperatures. This method uses a triple channel monochromator that is able to resolve the vibrational structure of diatomic molecular radiation, and a monitor channel to observe an electronic transition composed of many vibrational transitions. Measurements are made on incident nitrogen shock waves by observing the $\Delta v = +1$ sequence of the $N_2^+(1-)$ and $N_2(1+)$ systems. In addition to giving nonequilibrium temperature results, this experiment has given equilibrium radiation intensities that indicate an f number at the 0,0 transition of 0.035. Author

N64-28900* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON OSCILLATING SPHERE IN A ROTATING VISCOUS FLUID
M. P. Singh May 1964 9 p ref
(NASA-TM-X-55050; X-640-64-142) OTS: $1.10 ph

The moderate and large-scale motions of the atmosphere are greatly influenced by the vorticity of the earth's rotations. The manner in which small disturbances are propagated is the object of this study of the flow of a rotating fluid around elementary bodies. The problem of small oscillations of a sphere in an incompressible, viscous fluid rotating with a constant angular velocity is considered in order to determine the effect of the coriolis forces on the flow pattern. D.S.G.

N64-28952* Ling-Temco-Vought, Inc., Dallas, Tex.
UNSTEADY BOUNDARY-LAYER FLOW OF A NON-NEWTONIAN FLUID ON A FLAT PLATE
Curtis Sinclair Wells, Jr. Repr. from AIAA J. 1964 p 951–952 refs
(Contract NASw-729)

In a previous work that attempted to determine all possible similar solutions to the two-dimensional laminar boundary-layer equations for power-law non-Newtonian fluids, it was shown that one of the unsteady flow solutions corresponds to the physical situation of impulsively started flow on a flat plate at zero angle-of-attack. In this paper, the development of this particular solution is traced from the general boundary-layer equations and similarity considerations. The "inverse problem" technique is used, i.e., manipulating the general boundary-layer equations to find the conditions under which mathematical similarity (velocity profiles that transform linearly in y) exists. In addition, a generalized method is used in presenting numerical calculations for the impulsively started flow on an infinite flat plate. M.P.G.

N64-28960 Aeronutronic, Newport Beach, Calif.
JET INTERACTION TEST PROGRAM (CCN NO. 39). TEST REPORT Engineering Analysis Technical Note No. 30
A. I. Karydas and H. T. Kato 22 Jun. 1964 85 p refs
(Contract AF 04(694)-23)
(U-2634; AD-602254)

An experimental and theoretical investigation was conducted to study the jet impingement forces on a right circular cylinder in the flow field of a rocket nozzle exhausting into a vacuum or near-vacuum environment. In the theoretical investigation, an approximate method based on radial flow of the exhaust jet and a Newtonian approximation was developed to predict the jet impingement forces on a cylinder in a vacuum. The experimental investigation was performed in high-altitude chamber to determine the jet impingement forces and pressures on two instrumented cylinder models. Unheated nitrogen gas was exhausted from a conical nozzle into the test chamber at a nominal starting altitude of 250,000 ft. Six positions of the cylindrical models relative to the nozzle exit were investigated. Author

N64-28963 Aeronautical Research Council (Gt. Brit.)
THE EFFECTS OF HIGH PRESSURE ON THE FLOW IN THE REFLECTED SHOCK TUNNEL
L. Davies, L. Pennelegion, P. Gough, and K. Dolman London, HMSO, 1964 25 p refs
(ARC-CP-730; Supersedes NPL-AERO-1072, ARC-25071) HMSO: 5s 6d

It has been found necessary to increase the overall pressure level of shock tunnels owing to the emphasis and need, especially in the U.S.A., to have flight simulation of reentry and hypersonic cruise conditions. Helium and hydrogen as driver gases are to be used at pressures up to 20,000 lb/in.^{2} in facilities currently under construction. Subject to overcoming the mechanical engineering difficulties associated with high-pressure containment, it has been generally assumed that the capability of the shock tunnel would be increased proportionally in pressure and density by the ratio of the change in driver pressure. Experiments using helium and nitrogen at steady driving pressures up to 10,000 p.s.i. have supported theoretical considerations of the bulk properties of gases at high pressure, and shown that the available testing time is markedly reduced. Author

N64-28984 Federal Aviation Agency, Washington, D.C.
SOME CONSIDERATIONS OF SONIC BOOM
J. Kenneth Power May 1961 30 p refs
(AD-602173)

Available test data on sonic-boom overpressures are summarized and compared with predicted theoretical results. The physical basis for the lift critical and volume critical theories is discussed. Although sonic-boom theory based on volume effects is well substantiated by test results at medium altitudes, any theory that neglects change of angle-of-attack with altitude may not accurately predict boom pressures of heavy airplanes at high altitudes. Levels of boom overpressures that can cause adverse public reaction and even structural damage are indicated. The implications of sonic boom upon future supersonic commercial aircraft design and operations are considered. M.P.G.

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-27881* Pennsylvania State U., University Park Ionosphere Research Lab.
A STUDY OF THE IONOSPHERE AT MID LATITUDES BASED ON TOTAL ELECTRON CONTENT Scientific Report, Jul. 1961–Jun. 1962
Francis H. Hibberd 10 Jul. 1964 44 p refs
(Grant NsG-114-61)
(NASA-CR-56935; SR-213) OTS: $4.60 ph

This report describes a study of the total electron content of the ionosphere, derived from satellite doppler measurements, for July 1961 through June 1962. By combining the electron

content with simultaneous values of the maximum electron density and true height data obtained from a nearby ionosonde, scale heights and temperatures were obtained. The variations of the electron content and other ionospheric parameters with time of day, season, solar radio flux, and magnetic disturbance were investigated. Author

N64-28048 Joint Publications Research Service, Washington D.C.
THE CHARACTERISTICS OF SEISMIC PHASES Pt AND St
Mei Shih-Jung *In its* Transl. on Communist China's Sci. and Technol. No. 100 30 Jul. 1964 p 63-70 refs (See N64-28041 20-07) OTS: $3.00

Pt and St are two seismic phases that take place several seconds later than the normal P and S waves. They appear as a series of waves, generally every 8 to 10 seconds, and their intensity is usually higher than that of P and S. It is clearly apparent on earthquake records that they are seismic phases with epicentral distances of 6° to 30°. Although these seismic phases have been occasionally mentioned in manuscripts, systematic research has not been conducted into them. This article is a preliminary attempt to explain the characteristics of such seismic phases. The key point of this study is on the dynamic characteristics of the seismic phases. This analysis is based on the data of more than 80 earthquakes, whose epicentra are distributed in the seismic belt from Formosa, through the Ryukyu Islands to Honshu Island, Japan. Author

N64-28071* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETIC CONTROL OF DIFFUSION IN THE UPPER ATMOSPHERE
S. Chandra and R. A. Goldberg May 1964 31 p refs
(NASA-TM-X-55046; X-615-121) OTS: $3.60 ph

In many recent papers concerned with providing an explanation for the geomagnetic anomaly, agreement with measured data was obtained from the equations of motion for electrons and ions when used with an empirical boundary condition, whereas poor agreement has resulted from attempts to numerically integrate the commonly employed form of the continuity equation. This discrepancy is explained by demonstrating that the assumptions used to derive this form of the continuity equations do not agree with observation. Since the equations of motion do provide a favorable description for the geomagnetic anomaly, the possible physical models leading to the form of the equations used were studied, although field-aligned diffusive equilibrium provides the correct form, a more reasonable assumption concerning electron and ion collisions with neutrals also leads to the same result. By combining the equations of motion for neutrals, electrons, and ions, indication of geomagnetic control for the neutral atmosphere in the lower F-region of the ionosphere was possible, although the exact shape of this distribution is unknown. Author

N64-28080* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AURORA
Bengt Hultqvist Apr. 1964 179 p refs
(NASA-TM-X-55041; X-611-64-97) OTS: $12.50 ph

An introductory description of aurora is given. The morphology of visual aurora is discussed in detail. Correlation is made between aurora and solar and geophysical phenomena. Direct observations of energetic particles associated with aurora are reported. Theoretical models are described. G.D.B.

N64-28237 Weizmann Inst. of Science, Rehovoth (Israel)
PROPAGATION OF AN SH-TORQUE PULSE IN A SPHERE Technical Note No. 9
Z. Alterman and P. Kornfeld 10 Jul. 1964 58 p refs
(Contract AF 61(052)-509; Proj. Vela-Uniform)
(AFCRL-64-647; AD-444671)

An exact solution is obtained for the displacement of the surface of a uniform solid sphere of radius *a* due to an impulsive SH-torque-pulse from a point source situated at a distance *b* from the center. The duration of the source was varied from 0.05 a/c to 0.5 a/c keeping the time variation of the torque such that the surface displacement stays finite when the time tends to infinity. The *c* is the shear-wave velocity. Theoretical seismograms were computed at several distances from a surface source and from buried sources at b = 7a/8, a/2, 0.3a, and 0. Arrival times of reflected pulses coincide with times of arrival of reflected rays, where the latter are obtained according to geometrical optics. The solution for buried sources reveals diffracted pulses. They are connected with the two cases in which reflected rays are disallowed by geometrical optics—due to distance of observer from source, and due to depth of source. In these cases the arrival time as obtained from the steepest-descent analysis of Jeffreys and Lapwood is complex. The real part of the complex arrival times lies in the time interval during which diffracted pulses occur. There are no diffracted pulses for the surface source. Author

N64-28252 Weapons Research Establishment (Australia) Dept. of Supply
IONOSPHERIC DATA FOR OCTOBER 1963 FROM WOOMERA, SOUTH AUSTRALIA
Mar. 1964 24 p
(CPD-1963/10(W))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for October 1963. Author

N64-28278 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
AEROSOL DISTRIBUTIONS AND ATMOSPHERIC LIGHT-SCATTERING
Robert W. Fenn Dec. 1963 77 p refs
(USAELRDL-TR-2411; AD-601650)

This is a report of a study to investigate and explain the influence of the aerosol component on the total atmospheric scattering by direct comparison of measured aerosol distributions and light-scattering functions. The theoretical scattering properties of single spherical particles with various refractive indices were studied, and then the complex scattering functions for power-series-size distributions of such particles were derived. Especially the influence of various particle-size groups on the total scattering is pointed out. Author

N64-28280 Emmanuel Coll., Boston, Mass. Research Language Center
RESULTS OF RADAR TRACKINGS OF THE SOVIET SATELLITES "COSMOS I" AND "COSMOS II" IN THE CRIMEA ["REZUL'TATY RADIONABLIUDENII ISZ "KOSMOS I" I "KOSMOS II" V KRYMU"]
N. A. Mitiakov, E. E. Mitiakova, and V. A. Cherepovitskii Bedford, Mass., AFCRL, Mar. 1964 17 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiia (Moscow), v. 3, no. 5, 1963 p 816-822
(Contract AF 19(628)-3869)
(E-T-R-64-20; AD-442291)

This article gives the processing results of recordings of the phase difference in the signals of the 20.005 and 90.0225 mc coherent frequencies of the Soviet satellites Cosmos I and Cosmos II in the Crimea. The parameters of the ionosphere obtained are compared with vertical sounding data. Author

N64-28316* Geophysics Corp. of America, Bedford, Mass.
TIDES IN THE ATMOSPHERES OF EARTH AND MARS
Richard A. Craig Washington, NASA, Sep. 1964 50 p refs (Contract NASw-704)
(NASA-CR-97)

The theory of atmospheric tides, as developed for Earth's atmosphere, is applied to the Martian atmosphere. For corresponding modes of oscillation, equivalent depths are less in the Martian atmosphere than in Earth's atmosphere. On the other hand, the eigenvalue corresponding to the presumed Martian temperature distribution in the troposphere and stratosphere is about 20 km, about twice the corresponding value on Earth. These differences arise mainly from the different radii and masses of the planets. Unless the temperature distribution at high levels on Mars has a rather special form so that a second eigenvalue appears, no resonance magnification is to be expected. Tides in the Martian atmosphere might arise from periodic temperature oscillations, induced either by surface heating, or by radiative heating through deep layers of the atmosphere. Author

N64-28395 Joint Publications Research Service, Washington, D.C.
ENLARGED SESSION DEVOTED TO THE EARTH'S INNER STRUCTURE OF THE SCIENTIFIC COUNCIL OF THE GEOPHYSICAL INSTITUTE
B. Yu. Levin *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 406–411 (See N64-28376 20-29) OTS: $6.00

These are the minutes of a Soviet geophysical conference. Fourteen reports were presented at the session. These are briefly described, and biographical sketches of the authors are presented. G.D.B.

N64-28401 Joint Publications Research Service, Washington, D.C.
PROGRESS IN METEOROLOGY AND HYDROLOGY
26 Aug. 1964 67 p refs Transl. into ENGLISH of 11 articles from Meteorol. i Gidrol. (Moscow), no. 7, 1964
(JPRS-26139; TT-64-41398) OTS: $3.00

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N64-28402 Joint Publications Research Service, Washington, D.C.
HYDROGRAPH PRECALCULATION BY THE WATER BALANCE METHOD USING AN ELECTRONIC ANALOG COMPUTER
G. P. Kalinin and A. G. Levin *In its* Progr. in Meteorology and Hydrol. 26 Aug. 1964 p 1–11 refs (See N64-28401 20-12) OTS: $3.00

An attempt to use one of the simplest mathematical models to solve the equations of the water balance for the slopes of a basin, and equations describing the processes of transformation of the water supply as the water moves in the channel to a closing line are reported. An analog computer was used to solve the balance relation, taking into account the relationship between precipitation runoff and evaporation and their determining factors. This method for precalculation of the hydrograph was tested on two rivers flowing in different physicogeographic regions; the computed hydrographs generally agreed satisfactorily with actual measurement data, except in certain cases where there were serious deviations, indicating the need to include expressions for various other factors. M.P.G.

N64-28403 Joint Publications Research Service, Washington, D.C.
SHORT-PERIOD FORECASTING OF HIGH-WATER HYDROGRAPHS
L. M. Margolin *In its* Progr. in Meteorology and Hydrol. 26 Aug. 1964 p 12–19 ref (See N64-28401 20-12) OTS: $3.00

A method of predicting the high-water hydrograph and the volume of water runoff for 4, 5, 6, and 7 days at the time of rise and fall of high water is established. The analysis includes not only the water supplies in the main channels but also expressions for the remaining small and medium-sized rivers in the watershed. The water supplies in the channels of the large indicator rivers are multiplied by a given coefficient to give the water supply in the small and medium-sized rivers; the resulting values are then summed with the water supplies in the main rivers to obtain the total water supply in the river network of the basin. The advantages of using the total-water-supply figure in predicting high water levels are demonstrated by comparisons with the actual dropoff of high water in the Oka river at Kashira for the years 1953–1957. M.P.G.

N64-28404 Joint Publications Research Service, Washington, D.C.
MODERN MATHEMATICAL METHODS IN HYDROLOGY
L. S. Kuchment *In its* Progr. in Meteorology and Hydrol. 26 Aug. 1964 p 20–28 refs (See N64-28401 20-12) OTS: $3.00

A review of the mathematical methods that have been used for computer solution of hydrological problems is presented, including these: (1) solution of the St. Venant equations, using the grids and straight-line methods; (2) selection of hydraulic and morphometric information; (3) computation of nonstationary movement in rivers and reservoirs; (4) modeling of processes on large river and tributary network systems; (5) modeling of river runoff for flood-regulation systems; and (6) the use

of statistical models, such as the multiple regression method, information theory, multivariate statistical analysis, and Monte Carlo methods. M.P.G.

N64-28414* Massachusetts Inst. of Tech., Cambridge
A REPORT ON SOME RECENT MAJOR ELEMENT ANALYSES OF TEKTITES
C. C. Schnetzler and W. H. Pinson, Jr. Repr. from Geochim. Cosmochim. Acta, v. 28, 1964 p 793–806 refs
(Grant NsG-222-61; Contract AF 19(604)-6135)
(NASA-RP-291)

Forty-two tektites and two "amerikanites" were partially or completely analyzed for major elements. Included were 7 moldavites, 1 bediasite, 2 javanites, 15 philippinites, 12 indochinites, and 5 australites. Many chemical similarities are noted between the philippinites and indochinites, but the two groups appear different in SiO_2, Al_2O_3, TiO_2, and, in particular, CaO contents. No decrease in alkali element content is observed from Indochina to the Philippine Islands (i.e., west to east) as is observed across Australia. Tektites from two sites in the Philippine Islands are identical, within experimental error, in mean composition. The unity of chemical character of the australites and the southeast Asian tektites strongly suggest that they represent one large strewn field. New moldavite analyses do not indicate any systematic chemical variation across the Czechoslovakian strewn field. Author

N64-28428 Joint Publications Research Service, Washington, D.C.
STUDIES ON RIVER ICE FLOW AND SHIFTS
19 Aug. 1964 100 p refs Transl. into ENGLISH from Tr. Gos. Gidrol. Inst. (Leningrad), no. 103, 1963
(JPRS-25985; TT-64-41256) OTS: $3.00

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1. COMPUTATIONS AND PREDICTIONS OF SLUSH AND ICE FLOW DURING THE FREEZING PERIOD OF RIVERS R. A. Nezhikhovskiy p 1–58 refs
2. ON THE MECHANISM OF ICE COVER SHIFTS V. P. Berennikov p 59–80 refs
3. ON SOME TYPE OF MOUNTAIN RIVER ICE REGIME A. N. Chizhov p 81–98 refs

N64-28463* Consultants and Designers, Inc., Arlington, Va.
OBSERVATION OF ITINERANT DISTURBANCES IN THE LOWER AND UPPER IONOSPHERE [SUR L'OBSERVATION DE PERTURBATIONS ITINERANTES DANS L'IONOSPHERE INFERIEURE ET SUPERIEURE]
Jean-Marc Faynot 28 Jul. 1964 5 p refs Transl. into ENGLISH from C. R. Acad. Sci. Ionosphere (Paris), v. 258, no. 23, 8 Jun. 1964 p 5692–5695
(Contract NAS5-2078)
(NASA-TT-F-8936; ST-AI-10181) OTS: $1.10

Mechanisms that might explain itinerant disturbances observed in the lower and upper ionosphere are discussed. P.V.E.

N64-28492 Joint Publications Research Service, Washington, D.C.
ON PERMEABILITY OF ANISOTROPIC FISSURED ROCK
Ye. S. Romm and B. V. Pozinenko *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 328–338 refs (See N64-28469 20-01) OTS: $7.00

The aim of this article is to prove the tensor nature of permeability of fissured collectors of petroleum and gas, and to establish a relation between components of the tensor of permeability and fissure parameters of rocks. The discussions are concerned with the fissured rock pattern whose intergranular permeability along pore channels is zero (a purely fissured rock). Author

N64-28534 Oslo U., Blindern (Norway) Inst. of Cosmic Physics
VLF-EMISSIONS OBSERVED NEAR THE AURORAL ZONE. PART I: OCCURRENCE OF EMISSIONS DURING DISTURBANCES Scientific Report No. 4
Leiv Harang (Norweg. Defense Res. Estab.) and Reidulv Larsen 1964 19 p refs
(Contract AF 61(052)-680)
(AFCRL-64-627; AD-601902)

The VLF-emissions in the 8-kc/s band have been recorded, and bursts of enhanced emissions have been compared with geomagnetic records, absorption effects recorded via riometer, and appearance of aurorae. It is shown that bursts of enhanced radiations in the 8-kc/s band appear regularly during disturbed conditions near the auroral zone; the energy is of the order of 1 to 10×10^{-16} watts/m^2c. The occurrences of the bursts exhibit a pronounced diurnal variation, and the average duration of the bursts may vary from one minute to several hours, with a maximum occurrence of 10 to 12 minutes' duration. The VLF-emissions show a complicated dependence of geomagnetic disturbances and absorption within the ionosphere. Three cases of "noise storms" have been recorded during which the enhanced radiations appeared during the whole night. The "noise storms" coincided with great geomagnetic disturbances. The amplitude of the "storms" declined and disappeared when the ionosphere was illuminated by the sun's rays in the morning and when the normal daytime absorption was formed. J.L.C.

N64-28535 Oslo U., Blindern (Norway) Inst. of Cosmic Physics
VLF-EMISSIONS OBSERVED NEAR THE AURORAL ZONE. PART II: THE PHYSICAL PROPERTIES OF THE EMISSIONS Scientific Report No. 5
Leiv Harang (Norweg. Defence Res. Estab.) and Knut N. Hauge 1964 20 p refs
(Contract AF 61(052)-680)
(AFCRL-64-628; AD-603902)

The direction arrival of the VLF emission in the 8-kc/s band was studied using two crossed loops with their planes lying in east-west and north-south directions, and by switching the loops alternatively to the same amplifier channel. The VLF-noise level was higher in the east-west than in the north-south direction, and this higher east-west noise level was maintained during day and night. The VLF bursts came in on both frames with amplitudes of the same order of magnitudes. It is concluded that Tromsø is lying within an area of arrival of the VLF emissions; the energy is coming in from all directions. This point of view is confirmed through the polarization studies. Examples of amplitude distribution are demonstrated in which a strong VLF emission is being built up by series of sudden, discrete trains of bursts that gradually merge together into a continuous emission. The frequency analysis of a number of bursts in the range 5 to 13 kc/s is demonstrated. Author

N64-28536 Oslo U., Blindern (Norway) Inst. of Cosmic Physics
STUDIES OF LOCAL MORPHOLOGY, STRUCTURE AND DYNAMICS OF AURORA Summary Report, 1 Mar. 1963–31 May 1964
Leiv Harang et al [1964] 16 p refs
(Contract AF 61(052)-680)
(AFCRL-64-601; AD-603849)

A brief summary of results in the following areas is presented: rapid movements of auroral rays; the construction and application of a four-channel photometer for auroral research; current densities in visual aurora; temperature measurements; relation between auroral luminosity and ionospheric absorption; studies of the hydrogen line emissions; and very-low-frequency emissions from aurora. R.T.K.

N64-28547 Puerto Rico U., Mayaguez
IONOSPHERIC PROPAGATION STUDIES Final Report
Braulio Dueño 1 Jun. 1964 43 p refs
(Contract AF 19(604)-8342)
(AFCRL-64-443; AD-603776)

Conditions of minimum time delay focusing, for spherical earth geometry, are obtained, assuming on ionosphere with a parabolic distribution of electron density. Theoretical curves for the case of sweep-frequency backscatter are obtained that agree well with experimental values. A qualitative explanation of frequency-independent echoes is given in terms of the flat earth and ionosphere approximation, and unusual cases of motion of these echoes are explained. The diurnal and seasonal variations of backscatter echoes from the south for the years 1962 and 1963 are given and discussed. Author

N64-28630 Joint Publications Research Service, Washington, D.C.
PHYSICS OF THE UPPER ATMOSPHERE
N. I. Fedorova 5 Nov. 1962 10 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, Jul. 1962 p 112–114
(JPRS-16025; OTS-62-11795) OTS: $0.50

This article reviews papers presented at a Soviet conference on upper-atmospheric physics. The papers discussed the results of observations of night-glow emissions, Aurorae Polaris, twilight emissions, and other phenomena that occur in the upper atmosphere. G.D.B.

N64-28637 Adelaide U. (Australia)
MOLECULAR OXYGEN DENSITY AND LYMAN-α ABSORPTION IN THE UPPER ATMOSPHERE
J. H. Carver, P. Mitchell, E. L. Murray, and B. G. Hunt (WRE, Salisbury) [1963] 7 p refs

Rocket measurements of the absorption of solar ultraviolet radiation provide a powerful method for the determination of the composition of the upper atmosphere. Rocket measurements were made from Woomera, Australia, of the absorption of solar Lyman-alpha radiation (1,216 A) in order to determine the O_2 density above 70 km. The rocket was fired when the solar zenith angle was 37°. Nitric-oxide-filled ion chambers with lithium fluoride windows were used as the radiation detectors. In arriving at results, it was assumed that the O_2 density had a scale height of 6.5 km and the logarithm of the observed Lyman-alpha flux was plotted as a function of the absorbing mass in units of the slant mass above 70 km. Taking $\sigma = 1.00 \times 10^{-20} cm^2$ for the O_2 absorption cross section at the Lyman-alpha wavelength, it was found that the slope of the line in the plot of Lyman-alpha flux vs slant mass above 70 km corresponded to a slant mass above 70 km of 2.8×10^{20} O_2 molecules per cm^2 column. Correcting for the zenith angle, the vertical mass above 70 km was 2.2×10^{20} O_2 molecules per cm^2 column. The above mentioned plot may be used to extrapolate the observed Lyman-alpha flux above the atmosphere; the result is 5.4 ergs/cm^2/sec. I.v.L.

N64-28647 RAND Corp., Santa Monica, Calif.
POLLUTION OF THE UPPER ATMOSPHERE BY ROCKETS
W. W. Kellogg Jun. 1964 91 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3961-PR; AD-601768)

This report estimates the amounts of various constituents that would have to be continually injected by rockets into the upper atmosphere to double the worldwide natural concentrations there. Involved in the calculations are the natural atmospheric abundances of constituents such as H_2O, CO_2, NO, Na, K, Li, H, etc.; the residence times in various regions of the atmosphere, since these determine how rapidly a constituent will be removed; and the chemical or photochemical stability of a substance exposed to the upper atmosphere environment. A doubling of the CO_2, H_2O, or NO content would require per year on the order of 10^3 to 10^5 Saturn-type rockets, each injecting 100 tons of exhaust above 100 km. On the other hand, a few hundred small rockets per year, each containing 10 kg of the chemical, would probably double the Na content; similarly, less than two such rockets per year would be expected to double the Li content. Author

N64-28651* RAND Corp., Santa Monica, Calif.
ULTRAVIOLET SPECTROSCOPY OF THE UPPER ATMOSPHERE
R. O. Hundley Washington, NASA, Jul. 1964 49 p refs
(Contract NASr-21(07))
(NASA-CR-38) OTS: $1.25

This memorandum surveys the middle and vacuum ultraviolet spectroscopy of the upper atmosphere. The various physical and chemical processes involved in the interaction of radiation with the atoms and molecules of the upper atmosphere are reviewed. These processes include radiation absorption processes, such as photodissociation, photoionization, and resonance absorption; radiation scattering processes, such as Rayleigh scattering and resonance scattering, and radiation emission processes, such as chemiluminescence. The ultraviolet spectral features that result from these processes are summarized. Various ways are discussed in which rocket and satellite observations of these spectral features can be used to study the composition of the upper atmosphere. Author

N64-28688 Emmanuel Coll., Boston, Mass. Research Language Center
A METHOD FOR DETERMINING THE ELECTRON DENSITY PROFILE IN THE D-REGION OF THE IONOSPHERE [METHOD OPREDELENIIA PROFILIA ELEKTRONNOI PLOTNOSTI V OBLASTI D IONOSFERY]
K. Serafimov and G. Nestorov Bedford, Mass., AFCRL, Mar. 1964 14 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiia (Moscow), v. 3, no. 6, 1963 p 1059–1064 refs
(Contract AF 19(604)-8505)
(E-T-R-64-24; AD-602127)

On the basis of results measuring nondeviative absorption L'_D in the D-region with moderately high frequencies, the distribution law for electron density can be determined as a function of altitude. An integral equation for absorption using an analytical method of successive expansion by a Taylor's series is solved. Thus, by using the recorded L'_D during oblique incidence of an electromagnetic wave on a series of points, or by measuring absorption at several frequencies in the Al region, the form of N (z) in the D-region can be determined by simple methods, and its periodic variation can be controlled. Author

N64-28755* Rice U., Houston, Tex.
ROCKET-BORNE MEASUREMENT OF MID-LATITUDE AIRGLOW AND PARTICLE PRECIPITATION
B. J. O'Brien, R. Allum, and H. C. Goldwire [1964] 48 p refs

(Contract NASr-209)
(NASA-CR-58356) OTS: $4.60 ph

A simultaneous measurement of midlatitude night airglow and particle fluxes was made with a Nike–Apache rocket fired from Wallops Island, Virginia, near midnight and new moon. The rocket carried two photometers, three geiger counters, two scintillators, and two magnetometers as aspect sensors. The experiment conclusively demonstrated with three independent techniques that midlatitude 5,577 A night airglow is not excited by charged particle bombardment as is the case with auroras. The altitude profile was measured with high precision, and with its peak at 94.5 ±0.3 km and its half-width of 5.8 ±0.3 km, and was much narrower than would be produced by particle fluxes of various energy spectra and pitch-angle distributions. The actual particle fluxes were measured, and they could have produced much less than 1 R of 5,577 A around the altitude where it was brightest. The results, therefore, prove that less than approximately 3% of midlatitude 5,577 A night airglow can be termed a permanent aurora. Author

N64-28784 Saskatchewan U., Saskatoon (Canada) Inst. of Upper Atmospheric Physics
THE ANALYSIS OF TIME SEQUENCES WITH REFERENCE TO GEOPHYSICAL APPLICATIONS
K. V. Paulson Apr 1964 76 p refs
(Grant DRB-9511-25)
(RS-12)

Methods for analyzing the class of second-order stationary time sequences are developed as a means of deriving physical understanding from the enormous amount of available geophysical observational data. Using the stochastic rather than the functional approach, the probability background is established as the basis for discussing correlation functions, the spectrum, time invariant linear systems, two-dimensional spectra, stochastic fields, application of cross-spectral techniques to some analytical examples, the ergodic hypothesis, the estimation of spectra, and correlation times. Other methods of spectral analysis are briefly discussed. M.P.G.

N64-28800 RAND Corp., Santa Monica, Calif.
ELECTROMAGNETIC EFFECTS ASSOCIATED WITH THE SAN FRANCISCO FIREBALL OF NOVEMBER 7, 1963
Donald L. Lamar and Mary F. Romig Jun. 1964 14 p refs
(P-2924; AD-601901)

A report of an investigation of a fireball seen in the San Francisco area is presented. Investigated were reports of explosions or sonic booms heard at the time, power failures, radio interferences, and visual sightings of the fireball. It was found that the reported power failures and electromagnetic interferences (radio interference) could not definitely be said to be caused by the passage of the fireball. P.V.E.

N64-28855* Southwest Center For Advanced Studies, Dallas, Tex.
COMPOSITION CHANGES IN THE UPPER ATMOSPHERE
F. S. Johnson Repr. from Electron Density Distribution in Ionosphere and Exosphere, Proc. of NATO Advanced Study Inst., Skeikampen, Norway, 17–26 Apr. 1963 5 p refs
(Grant NsG-269-62; Contract CwB-10531)

Composition changes can occur at various altitudes in the upper atmosphere as a result of temperature changes that cause the atmosphere to expand or contract. If the physical conditions at the base of the diffusive equilibrium region (≈120km) remain constant while the atmospheric temperature at higher levels changes, the atmosphere will expand or contract, but the relative composition at any given pressure level will remain unchanged. Changes may also be brought about by large-scale circulations that must be expected to result from unequal heating of the upper atmosphere. Owing to the marked changes in composition that occur with altitude, due to the dissociation of oxygen and diffusive separation, any large-scale circulation pattern should be expected to exert a strong influence on atmospheric composition. Author

N64-28861 Weapons Research Establishment (Australia) Australian Defence Scientific Service
IONOSPHERIC DATA FOR NOVEMBER 1963 FROM SALISBURY, SOUTH AUSTRALIA
Apr. 1964 26 p *Its* Ionospheric Data Bull. CPD-1963/11(S)

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for November 1963. Author

N64-28877 Pennsylvania State U., University Park Ionosphere Research Lab.
METHODS FOR OBTAINING ELECTRON DENSITY PROFILES FROM CAPACITIVE IONOSPHERIC ROCKET PROBES Scientific Report No. 208
P. E. Crouse 15 May 1964 67 p refs
(Contract AF 19(628)-4050; Grant NsG-134-61)
(NASA-CR-58605; AFCRL-64-529) OTS: $6.60 ph

Two rockets were fired in which the nose-cone was insulated and the resistive and capacitive components of the admittance of two frequencies were measured between this insulated portion of the rocket and the main rocket body. A previous report described the theory on which the reduction of these measurements to electron density and collision frequency profiles can be accomplished. This procedure has since been modified to utilize the Sen–Wyller generalization of the Appleton–Hartree equation and has been applied to the analysis of the two experiments. Electron-density and collision-frequency profiles for the two experiments are presented. Author

N64-28898* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE HEIGHT OF AURORAL ABSORPTION, II
Bengt Hultqvist May 1964 21 p refs
(NASA-TM-X-55057; X-611-64-155) OTS: $2.60 ph

Statistical data from Alouette and Injun 3 giving the average precipitation rate of electrons in the auroral zone as a function of energy, are analyzed with regard to the average radio-wave absorption produced by ionization by electrons in the energy ranges 1 to 40 kev and 40 to 250 kev. From the satellite data, the higher energy range for the primary electrons is the dominating one in producing absorption at riometer frequencies. From this it follows that the majority of auroral absorption takes place below 90-km altitude in the auroral zone. Author

N64-28922* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS III. RADIATION DATA USERS' MANUAL SUPPLEMENT. CORRECTION MODELS FOR INSTRUMENTAL
W. R. Bandeen, R. E. Samuelson, and I. Strange 1 Dec. 1963 66 p refs
(NASA-TM-X-51825) OTS: $6.60 ph

This manual supplement discusses the additional evidence about the apparent degradation of the response of the five-channel, medium-resolution radiometer, and elaborates on the discussion of instrumental degradation in Section VI of the TIROS III Manual. This evidence arose from several different investigations using the radiation data from TIROS III. D.E.W.

N64-28945* Southwest Center For Advanced Studies, Dallas, Tex.
DYNAMIC DIFFUSION PROCESSES IN THE EXOSPHERE
W. B. Hanson Repr. from Electron Density Distribution in Ionosphere and Exosphere, Proc. of NATO Advanced Study Inst., Skleikampen, Norway, 17–26 Apr. 1963 11 p refs
(Grant NsG-269-62)

The diffusion of protons into and out of the protonosphere is unlikely to be large enough so that interhemisphere ion transport can be important in determining the F2 peak ionization. Nevertheless, during magnetic storms, the thermal ion component of the magnetosphere can be essentially depleted by a "greenhouse" mechanism. The importance of dynamic diffusion processes in determining the scale height of the various ion species above the F2 peak is pointed out; these considerations, plus the uncertainty in the plasma temperatures, make the interpretation of electron concentration profiles (such as are obtained from the Alouette satellite) in terms of diffusive equilibrium ion distributions very tenuous. Author

N64-28974* Smithsonian Astrophysical Observatory, Cambridge, Mass.
TEMPERATURE VARIATIONS IN THE UPPER ATMOSPHERE DURING GEOMAGNETICALLY QUIET INTERVALS
L. G. Jacchia and J. Slowey 15 Jun. 1964 9 p refs
(Grant NsG-87-60)
(NASA-CR-56882; SAO-152) OTS: $1.10 ph

These temperature variations are very nearly proportional to the variations in the K_p index, in contrast with the temperature variations during magnetic storms, which show proportionality with the a_p index. When $K_p < 3$, the temperature increase corresponding to a unit increase in K_p is about 40°. This corresponds to a value of $\Delta T/\Delta a_p$ close to 8°, six or seven times larger than that found in magnetic storms. Since the average value of K_p outside magnetic storms is about 2, the temperature on undisturbed days must be about 80° higher than that corresponding to $K_p = 0$. This again raises the question whether no heat source other than solar EUV is present when $K_p = 0$. Author

N64-28976 International Geophysical Year World Data Center A, Washington, D.C.
CATALOGUE OF DATA FOR AIRGLOW AND IONOSPHERE, AURORA, GEOMAGNETISM, COSMIC RAYS, AND SOLAR ACTIVITY RECEIVED BY WDC-A DURING THE PERIOD 1 JULY 1957–31 DECEMBER 1963
Jan. 1964 123 p refs

Data are cataloged by month from July 1, 1957, to December 31, 1963. Data on airglow and the ionosphere are cataloged by type of data and by observing station. Auroral data from photographic and visual observations are cataloged by station. Cosmic-ray data are cataloged in groups by station for each type of instrument. Geomagnetic data are divided into two groups—data before January 1960 and data after December 1959. Magnetograms and tellurigrams are cataloged by station and month in the first group, and other types of records are similarly indexed in the second group. Solar activity is cataloged by type and then by observing station. D.E.W.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-28075 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
THE MACROSCOPIC FOUNDATION OF IRREVERSIBLE THERMODYNAMICS
Eric F. Lype 18 Mar. 1963 31 p refs

By applying the laws of Lagrangian mechanics to thermodynamic phenomena, the need for a macroscopic axiom governing dissipative processes is demonstrated. By combining these laws with the second law of thermodynamics, the required axiom is formulated. From this axiom is obtained a condition of constraint, which, when added to Hamilton's principle, yields Biot's form of the Lagrangian equations for a dissipative process. Onsager's reciprocal relations, as well as other established theorems of irreversible thermodynamics, can be derived from this new axion of thermodynamics. Author

N64-28082* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
AN EXPERIMENTAL STUDY OF THE POOL HEATING OF LIQUID HYDROGEN IN THE SUBCRITICAL AND SUPERCRITICAL PRESSURE REGIMES OVER A RANGE OF ACCELERATIONS
Robert W. Graham, Robert C. Hendricks, and Robert C. Ehlers Washington, NASA, 1964 24 p refs Presented at the Cryogenic Eng. Conf., Philadelphia, 17–21 Aug. 1964
(NASA-TM-X-52039) OTS: $2.60 ph

Pool heating of liquid hydrogen in the subcritical and supercritical pressure states has been investigated at earth gravity and multigravities. Acceleration does influence the incipience of nucleate boiling, but does not affect established nucleate boiling. The film-boiling heat transfer is influenced by multigravity accelerations. A boiling-like mechanism was evident for hydrogen in the supercritical and near-critical state. Acceleration magnitude influenced the heat transfer in this fluid regime. Author

N64-28136 European Atomic Energy Community, Brussels (Belgium)
LEVEL INDICATION MEASUREMENTS, WETTING AND BUBBLE INDICATION OF LIQUID SODIUM IN A STAINLESS STEEL CONTAINER [MESSUNGEN ZUR FULLSTANDANZEIGE, ZUR BENETZUNG UND ZUM BLASENNACHWEIS BEI FLUSSIGEM Na IN EINEM BEHALTER AUS NICHTROSTENDEM STAHL]
K.-H. Spiller and D. Perschke Joint Nucl. Res. Center, Ispra Estab. (Italy), Heat Exchanges Serv., Jun. 1964 39 p in GERMAN; ENGLISH summary
(EUR-1823.d) Available from Belg. Am. Bank and Trust Co., N. Y., account no. 22.186: 60 Belg. Fr.

With a pool-boiling device manufactured of stainless steel, tests were made with Na to determine the registration of charge levels, wetting, and bubbles. The method is based on changes in electrical resistance. The level indication by an absolute method (calibration in ohms) was poor. A relative method is useful. Author

N64-28177 General Dynamics/Astronautics, San Diego, Calif. Space Science Labs.

THEORETICAL CALCULATIONS OF THERMODYNAMIC PROPERTIES OF AIR

Adolf R. Hochstim *In* AGARD Combust. and Propulsion 1963 p 3-43 refs (See N64-28176 20-11)

(Partially Sponsored by ARPA) Pergamon: £7

A review of the calculations of the equilibrium properties of high-temperature air is given. A description of existing tables and of approximate models with closed-form analytical solutions is presented. Equations are derived for real-gas corrections for partially dissociated and ionized gases. The effect of long-distance Coulomb interactions on thermodynamic properties is derived from the Meeron theory to higher order than is given by the Debye-Hückel theory. A new, simple method for an exact calculation (in closed form) of an ideal multicomponent, multiply ionized plasma at very high temperatures is presented with some numerical illustrations. A short table of various thermodynamic properties of air from 300° to 3000° K is given, which takes into account dissociation of oxygen, nitrogen, and nitric oxide. Author

N64-28178 Technische Hochschule Carolo Wilhelmina, Brunswick (W. Germany) Inst. of Chemical Technology

CALCULATION OF EQUILIBRIA OF HYDROCARBONS HEATED TO HIGH TEMPERATURES, INTENSELY HEATED AIR, AND TEMPERATURE MEASUREMENTS IN ELECTRIC ARCS

H. Kroepelin *In* AGARD Combust. and Propulsion 1963 p 45-60 refs (See N64-28176 20-11) Pergamon: £7

Much of the experimental work was devoted to studies of the effect of electric arcs on hydrocarbon vapor, hydrocarbon-nitrogen vapors, and hydrocarbon-ammonia vapors. The purpose of these experiments was to produce acetylene from heavy hydrocarbons and to produce, simultaneously, acetylene, and HCN from heavy hydrocarbons and nitrogen. Temperatures and temperature distributions in the electric arc were measured. Since the only direct data obtainable from many of the measurements were quantities dependent upon temperature, it was necessary to use theoretical calculations on the relation between such quantities and the temperature (for instance, the composity of a gaseous compound or its density as a function of temperature). Representative equilibrium compositions calculated for gaseous compounds, conclusions with regard to certain reaction mechanisms, and the results of temperature measurements taken in electric arcs are presented. I.v.L.

N64-28179 Clarke, Chapman and Co., Ltd., Gateshead (Gt. Brit.)

SOME ASPECTS OF THE KINETIC THEORY OF GASEOUS THERMODYNAMICS

G. H. A. Cole *In* AGARD Combust. and Propulsion 1963 p 61-83 refs (See N64-28176 20-11) Pergamon: £7

This article is concerned with a brief survey of some aspects of the theory of thermodynamics of a real un-ionized gas. The nature of the actual intermolecular force is accounted for by basing the theory on the requirements of extended molecular interactions between molecules of finite size. Classical arguments are employed throughout. The distribution functions necessary for the statistical treatment of matter are defined and considered. How a knowledge of these functions, and particularly the pair distribution can lead to a knowledge of the thermodynamic functions is shown. Pair distribution is determined, and the superposition approximation is introduced. In addition, the kinetic theory developed is considered in the light of the hard sphere and well potentials, particularly, and reference is made to other potentials. I.v.L.

N64-28189 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.

AEROTHERMOCHEMISTRY STUDIES IN ABLATION

Henryk Hurwicz *In* AGARD Combust. and Propulsion 1963 p 403-455 refs (See N64-28176 20-11)

Pergamon: £7

Developments during the last 2 to 3 years in the field of ablation aerothermochemistry and material behavior are reviewed. The investigations of the interface between the boundary-layer gas and unactivated ablation material in transient rather than quasi-steady state are emphasized. Convective heat transfer with chemical corrosion, external and internal radiative energy transport, formation of liquid layers and evaporation, internal conduction and convection, and thermochemical decomposition in ablating materials are discussed. Engineering aspects of the utilization of ablation cooling principles—one- and two-dimensional machine computation-simulation programs, material and medium property and characteristics determination—are discussed. Author

N64-28230* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

AN ANALYSIS OF SECOND-ORDER SLIP FLOW AND TEMPERATURE-JUMP BOUNDARY CONDITIONS FOR RAREFIED GASES

R. G. Deissler Oxford, N.Y., Pergamon, 1964 Repr. from Intern. J. Heat Mass Transfer, v. 7, 1964 p 681-694

(NASA-RP-294)

The effects of second-order terms on the velocity and temperature jumps at a wall are obtained by a physical derivation. The analysis uses the concepts of effective mean free paths for momentum and energy transfer; the effective mean free paths are obtained from known viscosities and thermal conductivities. The second-order slip flow analysis is applicable at somewhat lower pressures than is the first-order analysis and applies to nonmonatomic as well as to monatomic gases. Several illustrative examples, including fully developed flow and heat transfer in a tube, are considered. Differences between the first- and second-order corrections on the order of 20% were noted in the region for which the analysis appears applicable. Author

N64-28234* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANALYTICAL STUDY OF THE EXPANSION AND CONDENSATION BEHAVIOR OF ALKALI-METAL AND MERCURY VAPORS FLOWING THROUGH NOZZLES

Arthur J. Glassman Washington, NASA, Sep. 1964 26 p refs (NASA-TN-D-2475) OTS: $0.75

The equilibrium and frozen modes of nozzle expansion were compared in order to determine the significance of the expansion mode assumption. A condensation analysis was then conducted in order to gain some insight to the true expansion mode. Nucleation rates were examined, and condensation theory was applied to flow in nozzles. Sodium, potassium, rubidium, cesium, and mercury were investigated at nozzle inlet temperatures of 1,700° to 2,500° R for the alkali metals and 1,200° to 1,600° R for mercury. Author

N64-28253 European Atomic Energy Community, Brussels (Belgium)

DETERMINATION OF THE HEAT DIFFUSION RATE IN INSULATING MATERIALS USING A VERY SHORT IMPULSE [DETERMINATION DE LA DIFFUSITIVE THERMIQUE DES ISOLANTS PER LA METHODE DU SIGNAL TRES BREF]

J. Faure Joint Nucl. Res. Center, Ispra Estab. (Italy), Technol. Serv., Jun. 1964 38 p refs in FRENCH; ENGLISH summary (EUR-1822.f) Available from Belg. Am. Bank and Trust Co., N.Y., Account no. 22.186: 60 Belg. Fr.

The classical theory that determines the thermal diffusion rate from the propagation of a heat impulse cannot be used in case of low conductivity materials. The signal propagation is too slow, and thermal losses for which the classical theory does not account cannot be neglected. In the present case, the mathematical formulation was corrected to account for this effect. The problem was solved, and a simple apparatus has been designed to measure the thermal diffusion of insulating materials up to a temperature of 400° C. Author

N64-28255 Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF TRANSIENT TEMPERATURES IN TURBINE BLADES AND TAPERED DISCS USING BIOT'S VARIATIONAL METHOD
P. W. H. Howe London, HMSO, 1963 40 p refs
(ARC-CP-617; supersedes NGTE-M-352, ARC-23519) HMSO: 5s 6d

Transient temperatures in aerofoil sections and tapered discs are calculated taking advantage of simplifications in heat flow analysis achieved in Biot's variational method. Cross sections are represented by a line of adjacent squares of various sizes suitable for the local dimensions, e.g., small squares near the leading and trailing edges. The potential, dissipation, and surface dissipation functions of Biot's method are set up, and the Lagrange equations lead, by automatic procedures, to an eigenvalue formulation in matrix form for the temperatures and their first time derivatives. Solutions are sums of exponentials in time, and are evaluated by digital computer, requiring about five minutes for each cross-section and heat-transfer coefficient. Author

N64-28351* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
DIFFUSION APPROXIMATION FOR THERMAL RADIATION IN GASES WITH JUMP BOUNDARY CONDITION
R. G. Deissler Repr. from J. Heat Transfer, v. 86, May 1964 p 240–246 refs Presented at the ASME-AIChE Heat Transfer Conf. and Exhibit, Boston, 11–14 Aug. 1963
(NASA-RP-282; ASME Paper-63-HT-13)

Generalized equations are obtained for radiative diffusion in a nongray gas and for the energy jump at a wall. By using the second-order energy jump at a wall, the diffusion approximation for radiation in a gas is improved considerably, the range of validity of the approximation being extended to lower values of optical thickness. Author

N64-28458 Brown U., Providence, R. I.
TEMPERATURE STRESSES IN THE-TWO-PHASE ALLOY, Al-Si
Chain Tsuan Liu and Joseph Gurland May 1964 40 p refs
(Contract AT(30-1)-2394)
(TR-5)

Temperature stresses in aluminum–silicon alloys were measured by X-ray diffraction methods. The experimental results are compared to values calculated on the basis of elastic–plastic theory. The effects of composition and microstructure are also considered. Author

N64-28488 Joint Publications Research Service, Washington, D.C.
ON TEMPERATURE FIELD INDUCED BY HEAT ENERGY RELEASED BY WIDENING OF TANGENTIAL BREAK
Yu. S. Ryazantsev *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 296–299 ref (See N64-28469 20-01) OTS: $7.00

Tangential breaks in magnetic hydrodynamics can be stable in regard to infinitesimal disturbances. However, with the progression of time the tangential breaks widen due to constants of viscosity and electrical resistance. This process is accompanied by heating of the surrounding medium. In this note, it is assumed that a nonstationary field is induced by heat energy released by dissipation and that the medium is noncompressible. Author

N64-28491 Joint Publications Research Service, Washington, D.C.
COWPER HEATER CALCULATIONS
V. Ye. Chekalin *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 318–327 refs (See N64-28469 20-01) OTS: $7.00

This work solves the problem for a cowper heater equipped with thin-walled heat-conductive heating elements at any specified gas-flow rate. Given are the method of cowper heater calculation at constant gas-flow rate and the method of calculation of cowper system with a bypass arrangement. Author

N64-28493 Joint Publications Research Service, Washington, D.C.
TEMPERATURE FIELD OF CYCLICALLY DEFORMED ELASTO-PLASTIC MEDIUM
V. V. Moskvitin *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 339–347 refs (See N64-28469 20-01) OTS: $7.00

A solution to the problem of the heat intensity generated when large specimens or working parts are tested under dynamic loads with the presence of plastic deformations is computed. This calculation is important because such heating can cause disturbances in stress and deformation distribution. It is assumed that the entire energy dissipated per cycle is transformed into heat, so that each plastic element of the cyclically deformed medium becomes a source of heat, and the energy dissipated is determined by the area. The problem of primary loading is solved as the basis for application of the theorem of repeated loading; the temperature conditions that must be satisfied at the boundary of the zone under consideration, as well as on surfaces of the volume being considered, are determined; and the solution of the problem is derived. The application of this formula in solving the cyclic torsion of an elastoplastic rod with a round cross section is presented as an example. M.P.G.

N64-28564 Columbia U., New York, N.Y.
ON THE TEMPERATURE-TIME EQUIVALENCE OF THERMORHEOLOGICALLY SIMPLE VISCOELASTIC MATERIALS
M. Shinozuka May 1964 18 p refs
(Contract Nonr-266(78))
(TR-24; AD-604020)

For linear stress analysis of homogeneous, isotropic, thermorheologically simple viscoelastic materials, the hypothesis of temperature–time equivalence is stated explicitly with respect to the relaxation spectra. Because relaxation spectra among the various viscoelastic functions are most closely related to the molecular processes occurring in the material, the hypothesis stated with respect to spectra is expected to indicate more clearly the validity and limitations of stress–strain relations of thermorheologically simple materials. Author

N64-28589 National Gas Turbine Establishment, Pyestock (Gt. Brit.)
HEAT TRANSFER IN CHAMBERS

D. Reeves *In* AGARD Exptl. Methods in Combust. Res. 1964 27 p refs (See N64-28584 20-26)

An attempt was made to combine a review of the sparse literature on experimental heat-transfer work in chambers with more detailed descriptions of practical investigations. The most widely applied experimental method in the field has been the measurement of chamber-wall temperature. Both thermocouples and temperature-indicating paints have their uses, depending on whether precise local measurements or broad indications of distribution are the object of the study. For more fundamental research, direct measurement may be required of heat-transfer rates to or from the chamber walls; and in circumstances where the total heat flux is of interest, the choice is between calorimetric methods or heat-flow meters, depending on whether an overall average or a local value is required. For experimentally finding the separate magnitudes or proportions of the convection and radiation components contributing to the heat transfer in a chamber, it is possible to measure the radiation properties of flames, the Schmidt technique being the one recommended. By combining such data with measurements of total heat flux, the quantity contributed by convection can be deduced. A new method has been proposed by which the convective heat-transfer coefficient can be extracted analytically from the measurements of total heat flux yielded by a thermoelectric heat meter. Author

N64-28590 Explosives Research and Development Establishment, Waltham Abbey (Gt. Brit.)
HEAT TRANSFER IN ROCKET THRUST CHAMBERS
H. Ziebland *In* AGARD Exptl. Methods in Combust. Res. 1964 16 p refs (See N64-28584 20-26)

Methods for the study of heat transfer heat flux in rocket thrust chambers are reviewed. Specific references are made to the following: (1) continuous flow calorimetry; (2) a thermoelectric heat-flux element that has been applied to the determinations of heat flux in an experimental thrust chamber assembly where the heat-flux element formed an integral part of the combustion chamber; (3) the thermal capacitance transient state technique; (4) a circular heat-flow meter for providing point values of heat flux; (5) optical and flow-variation techniques for measuring radiative heat transfer (convection and thermal radiation). In addition, the use of thermal paints as indicators of heat transfer to the gas-side face of the injector is discussed. I.v.L.

N64-28591 Arkansas U., Fayetteville Coll. of Engineering
HEAT TRANSFER PHENOMENA IN ROCKET ENGINES
Helmut Wolf *In* AGARD Exptl. Methods in Combust. Res. 1964 29 p refs (See N64-28584 20-26)

This report is concerned with experimental techniques and methods for obtaining heat-transfer information for utilization in the design of rocket engine chambers and nozzles. It is divided into experimental methods for determining the energy transfer from the hot combustion gas to the chamber walls, and experimental methods concerned with means for absorbing that energy at or in the walls. Apparatus and associated techniques are described for measuring the heat-transfer characteristics of high-temperature gases, under cooling conditions, in a constant area duct and the heat-transfer characteristics of high-temperature combustion products in a variable area duct. Regenerative cooling, film cooling, and transpiration cooling are the methods discussed for energy absorption. I.v.L.

N64-28639 Library of Congress, Washington, D.C. Aerospace Information Div.
INVESTIGATION OF HEAT AND MASS TRANSFER IN THE EVAPORATION OF LIQUID IN A FORCED GAS STREAM
G. T. Sergeyev [1964] 14 p refs Transl. into ENGLISH of a RUSSIAN document
(AID-T-64-29; AD-601778)

This report presents results of an experimental study of the mechanism of heat and mass transfer in the interaction of fluid and moist bodies with a gas stream. In the first series of experiments, evaporation of water, acetone, benzene, and butanol from an exposed surface were investigated. A drip pan containing the liquid under study was placed in the working chamber of a wind tunnel together with a hollow metallic body indentical in form and size (the dry body) through which water flowed. In calculating heat exchange uncomplicated by mass exchange it is understood that all the heat received by the surface of the dry body is expended in heating the cooling water. Author

N64-28687 Massachusetts Inst. of Tech., Cambridge
HEAT TRANSFER DURING FILM CONDENSATION OF A LIQUID METAL VAPOR
Suhas P. Sukhatme and Warren M. Rohsenow Apr. 1964 74 p refs
(Contract AT(30-1)-2995)
(TR-9167-27; MIT-2995-1)

The object of this investigation is to resolve the discrepancy between theory and experiment for the case of heat transfer during film condensation of liquid-metal vapors. Experimental work to back up a hypothesis of a liquid–vapor interfacial resistance is presented. The working fluid for the experiments is mercury condensing at low pressures in the absence of noncondensable gases on a vertical nickel surface. Data of previous investigators are analyzed, and possible reasons for being unable to interpret these results meaningfully are cited. Author

N64-28706* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL SIMILITUDE STUDIES
Billy P. Jones Repr. from J. of Spacecraft and Rockets, v. 1, no. 4, Jul.–Aug. 1964 p 364–369 refs
(NASA-RP-300)

One of the initial objectives of work in thermal similitude is to determine modeling laws and techniques for application in thermal scaling of spacecraft and in research problems. Modeling laws for space vehicles are derived from the differential equations used in practice for thermal analysis. The necessary and sufficient conditions for complete thermal similarity between model and prototype take the form of 28 ratios that must remain constant. However, all of these ratios are not independent but contain independent sets of six ratios. An example of thermal scaling is given in which one independent set is used. The general results compare favorably with those of some investigators who used other methods. The purposes of full-scale thermal testing are discussed, and the usefulness of thermal scale modeling as a substitute for full-scale testing is questioned. It is suggested that the principles of similarity and scale modeling may find the most fruitful application in special research problems. Author

N64-28744* General Electric Co., Cincinnati, Ohio Missile and Space Div.
ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS. VOLUME I: EXPERIMENTAL PROGRAM Final Report, Jan. 1, 1961–Jun. 30, 1962
R. D. Brooks (ed.) 1 Jun. 1964 325 p refs
(Contract NAS5-681)
(NASA-CR-54050) OTS: $19.75 ph

The objective of this program is to investigate the boiling of potassium and sodium at temperatures up to 2,200° F and the condensing of these fluids up to 1,600° F. This report describes three test facilities—the 300-kw facility, the 100-kw facility, and the 50-kw facility—constructed for these experiments along with the design considerations that preceded the final selection of components and operating conditions. The instrumentation and the problems encountered in making the measurements sufficiently accurate for experimental purposes are also discussed. Requisite temperature, pressure, flow, and liquid-level measurements as well as the equipment developed for special applications are described. Pool-boiling experiments conducted at Columbia University are presented. Calculational procedures are given in the appendixes. I.v.L.

N64-28781 Iowa State U. of Science and Tech., Ames Ames Lab.
TEMPERATURE DISTRIBUTION IN A HOLLOW CYLINDRICAL MANOMETER COLUMN Research and Development Report
Dale Le Roy Smith and Ray W. Fisher Aug. 1963 50 p refs
(Contract W-7405-ENG-82)
(IS-805)

The longitudinal temperature distribution is determined for a finite hollow cylindrical monometer column with heat sources at the lower end and along the axis of the column. A nonlinear relation for the heat loss from the Inconel column to the atmosphere was determined empirically and used in the theoretical calculation of the temperature distribution. The theoretical solution involved the solution of two sets of equations containing double infinite series. Experimental measurements of the temperature distribution along the column were made using chromel-alumel thermocouples spotwelded to the surface of the column. The experimental measurements were compared with the theoretical results to prove the validity of the theory. Author

N64-28817 IIT Research Inst., Chicago, Ill.
OPTICAL SPECTRA USING THE MATRIX-ISOLATION TECHNIQUE Quarterly Technical Summary Report, Feb. 14–May 14, 1964
Alan Snelson [1964] 14 p refs
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)
(IITRI-C6013-4; AD-440840)

Determination of improved thermodynamic functions for some low-molecular-weight compounds formed in the exhaust gases of potential rocket-propellant systems is discussed. Work centered around the investigation of spectra of aluminum fluoride, beryllium chloride, magnesium fluoride, and calcium fluoride. Graphs and tables are presented that show the following: (1) matrix isolation spectrum of $BeCl_2$ in matrices of neon, argon, and krypton; (2) spectrum of $BeCl_2$ in matrix and solid phase; (3) matrix isolation spectrum of MgF_2 in matrices of neon, argon, and krypton; and (4) free-energy functions and entropy of magnesium fluoride in the ideal gas state. P.V.E.

N64-28819 National Research Corp., Cambridge, Mass. Contract Research Div.
THERMODYNAMIC PROPERTIES OF BIMETALLIC COMPOUNDS Quarterly Letter Report, Apr. 1–Jun. 30, 1964
Ludwig Fasolino 30 Jun. 1964 3 p
(Contract Nonr-3608(00); ARPA Order 23-61)
(AD-442550)

Major accomplishments in solution calorimetry are presented. Seven determinations of the heat of solution of B_2O_3 (crystalline), prepared from seeded H_3BO_3, in water were made where the molar ratio of B_2O_3:H_2) was 1:345. The resulting value was $\Delta H_{298} = -3.459 \pm 0.039$ kcal/mole. The heats of formation of B_2O_3 (amorphous) and B_2O_3 (crystalline) were calculated from measurements of the heats of solution of B_2O_3 (amorphous), H_3BO_3 (crystalline), and B_2O_3 (crystalline). These were $\Delta Hf_{298} = -299.30 \pm 0.07$ kcal/mole and $\Delta Hf_{298} = -303.63 + 0.05$ kcal/mole, respectively. A manifold for distilling and preparing samples of liquid BCl_3 was made. A closed bomb calorimeter was calibrated and employed in five measurements of the heat of solution of liquid BCl_3 in water (Molar ratio BCl_3:H_2O = 1:590.) The resulting value was $\Delta H_{298} = -69.12 \pm 0.11$ kcal/mole. I.v.L.

N64-28918* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
PURPOSES AND METHODS OF GAS TURBINE COOLING
Jack B. Esgar and Robert R. Ziemer [1953] 47 p refs
(NASA-TMX-51765) OTS: $4.60 ph

The use of turbine cooling permits increasing turbine inlet temperatures to a point where very large gains in engine performance are possible. In addition, a greater freedom in turbine design is obtained because of higher permissible stress levels and a larger choice of possible turbine materials. The gains to be made in engine performance and the methods that can be used to cool turbines are presented. Author

N64-29001* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THEORETICAL NOBLE-GAS PERFORMANCES IN AN IDEAL CONSTANT-AREA SHOCK TUBE
Wesley A. Menard 1 Mar. 1964 18 p refs
(Contract NAS7-100)
(NASA-CR-58283; JPL-TR-33-163) OTS: $1.60 ph

The analytical procedures described were developed to support an experimental investigation of the thermal conductivity of noble gases in a constant-area shock tube. To provide a more efficient means of choosing initial pressures for the driver and driven gases in the tube, the gasdynamic equations were solved by an iterative method, and curves were plotted for 10 combinations of helium or argon driving helium, neon, argon, krypton, or xenon. From these curves, the initial shock tube pressures may be easily determined for any given set of stagnation conditions. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-27889* Naval School of Aviation Medicine, Pensacola, Fla.
VISUAL CONTROL OF HABITUATION TO COMPLEX VESTIBULAR STIMULATION IN MAN
Fred E. Guedry, Jr. 5 May 1964 19 p refs
(NASA Order R-93)
(NASA-CR-56896; Rept.-95) OTS: $1.60 ph

Twenty men completed an experiment in a slow rotation room while it rotated for several hours at a rate of 45° sec. Subjects were immobile (relative to the room) except for habituation series that consisted of head movements restricted to one plane and to a particular quadrant of that plane. Visual

problems were presented with each head movement to one group of subjects; another group made all head movements of the habituation series in darkness. Tests conducted in darkness before and after the habituation series revealed pronounced reductions in nystagmus and subjective effects in the practiced quadrant only in the visual-task group. The other group showed no reduction of nystagmus in either the practiced or unpracticed quadrant. This experiment indicates that vision can be an important factor in habituation of human subjects to vestibular stimulation. Author

N64-27946* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A STUDY OF THE PILOT'S ABILITY TO CONTROL AN APOLLO TYPE VEHICLE DURING ATMOSPHERE ENTRY
Rodney C. Wingrove, Glen W. Stinnett, and Robert C. Innis Washington, NASA, Aug. 1964 49 p refs
(NASA-TN-D-2467) OTS: $1.25

Studies have been conducted on the manual control during entry of a space vehicle into the earth's atmosphere at parabolic velocities. These studies were conducted on a centrifuge where the pilot experienced the acceleration forces associated with the simulated flight. The pilot tasks in this study included (1) control to various acceleration levels, (2) control of range with various displays and various modes of short-period stability augmentation, and (3) monitoring and recovery procedures. Author

N64-28073* National Aeronautics and Space Administration, Washington, D.C. Scientific and Technical Information Div.
REPRO TYPING AND LAYOUT. PREPARING CONTRACTOR REPORTS FOR NASA
May 1964 19 p
(NASA-SP-7007) GPO: $0.15

The purpose of this booklet is to offer a few ground rules to enable, with a minimum of effort, the production of a perfectly suitable reproducible copy. Topics discussed are these: (1) the typewriter—its condition; (2) the reproducible layout sheet; (3) section headings; (4) spacing; (5) hyphenation; (6) error correction; (7) typing tables and figures; (8) the reproducible layout; (9) figuring reductions; and (10) typing equations. I.v.L.

N64-28104 Gt. Brit. Dept. of Scientific and Industrial Research Warren Spring Lab.
HUMAN SCIENCES IN INDUSTRY (ANNOTATED BIBLIOGRAPHY). PART I: ERGONOMICS
Jul. 1964 111 p refs

This annotated bibliography covers the following topics: biotechnology; systems of men and machines; visual inputs and processes; auditory inputs and processes, including speech production and intelligibility; other sensory inputs and processes; body measurements and basic physiological capacities; basic and complex motor performance; design of controls and integration with displays; layout of panels and consoles; design of work space, equipment, and furniture; clothing and personal equipment; special environmental factors affecting performance; individual factors, work conditions, and task characteristics that affect behavioral efficiency; training aids and devices and their use. R.T.K.

N64-28298 Naval Medical Research Lab., New London, Conn.
SPEECH INTELLIGIBILITY DURING PROLONGED EXPOSURE TO HELIUM-OXYGEN Memorandum Report No. 63-8
Russell L. Sergeant 13 May 1963 8 p refs
(AD-602545)

The purpose of this research was to determine whether the well-known Donald Duck effect on the human voice of breathing a mixture containing helium would continue when the breathing of this mixture was continued over a long period of time, or whether there might be some adaptation to this condition, which would produce more nearly normal voice sounds. Speech sounds showed a deterioration in their intelligibility after two days of exposure to HeO_2 mixture; however, by the fourth and sixth day of exposure a return to more normal speech was noted. Author

N64-28604 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio Behavioral Sciences Lab.
THE EFFECT OF DIRECTION AND SPEED OF IMAGE MOTION UPON TARGET DETECTION WITH SIDE-LOOKING RADAR
Fen Rhodes and H. C. Self Jun. 1964 14 p refs
(AMRL-TDR-64-45; AD-603598)

Sixteen navigator–bombardiers were required to find airfields, bridges, railroad yards, and tank farms on side-looking radar imagery when the imagery was moving either vertically, top to bottom; or horizontally, left to right. The imagery was presented at simulated aircraft speeds of either Mach 1 or Mach 2.8 on a 14 by 14 inch rear projection screen at a scale of 1:93,900. The average distance that targets traveled on the screen before being detected was significantly less for the vertical condition. However, neither the number of targets detected nor the proportion of false targets reported was significantly influenced by the direction of image motion. More targets were detected, and the average distance the target traveled before being detected was less at the slower speed. Image speed had no significant effect on the number of false targets reported. Author

N64-28636 Educational Research Corp., Cambridge, Mass.
JAMES J. GIBSON ON VISUAL PERCEPTION: ANALYSIS OF SELECTED PAPERS
Milton W. Horowitz Feb. 1964 43 p refs
(Contract N 61339-294)
(NAVTRADEVCEN-294-5; AD-602283) OTS: $1.25

This paper is an analysis of Gibson's point of view in psychology. It is primarily based on 50 scientific papers published in scholarly journals by him and his colleagues, but to some extent it also mirrors the research of other writers in the field of perception. Although these papers cover 20 years of Gibson's life, and hence reveal his evolution as a scientist to some extent, the great majority of them have been published in the last 10 years, when his work had become programatic, and reveal a systematic progress in the field of visual perception. The report indicates the general principles of visual perception that have been explicated by Gibson with a view toward the eventual utilization of these principles in the construction of visual displays for training purposes. Author

N64-28696 Naval Air Development Center, Johnsville, Pa. Aeronautical Computer Lab.
APPLICATION OF HARMONIC ANALYSIS IN A STUDY OF TRACKING PERFORMANCE IN THE TV-2 AIRCRAFT AND IN CENTRIFUGE AND STATIONARY SIMULATIONS OF THAT AIRCRAFT
H. G. Tremblay, John L. Brown, and A. Futterweit 30 Apr. 1964 28 p refs
(NADC-AC-6406; AD-602178)

Piloting performance in a continuous tracking task was studied in an aircraft, in human centrifuge simulations controlled by a computer simulation of the aircraft, and in a stationary simulation. Continuous records of elevator and aileron

control surface deflections were subjected to a power spectral density analysis. Results indicate that there is a reduction in the contributions of high-frequency components of power, successively, from the static simulation to the centrifuge simulations, to the aircraft itself. The power spectral density function for performance in a centrifuge simulation is more like that for the aircraft than is the power spectral density function in a static simulation. Author

N64-28902 Naval Training Device Center, Port Washington, N.Y. Human Factors Lab.
EMPTY VISUAL FIELD STUDIES: SOME EFFECTS OF CORRECTIVE LENSES, FILTERS, AND STRUCTURE
Milton S. Katz, Paul A. Cirincione, and William Metlay 22 Jun. 1964 28 p refs
(NAVTRADEVCEN IH-14; AD-445863)

A total of six false target detections was made by all subjects during data collection. These false detections were not characteristic of any single subject or experimental condition. Because of the extremely small percentage that these represent (.002%), no further analysis was made. The effect of structure in the visual field was assessed by a comparison of the number of targets detected in each field. The differences in target detection scores between the structured visual field and the homogeneous visual field were found to be significant ($p<.01$). Target detection scores for all treatments combined and plotted as a function of target size are shown. Author

N64-28948* North American Aviation, Inc., Columbus, Ohio
OPERATOR PERFORMANCE IN SIMULATED LOW-ALTITUDE HIGH-SPEED FLIGHT.
Stanley M. Soliday [1964] 4 p refs Preprint of a Paper Presented at the Aerospace Med. Assn. 35th Ann. Sci. Meeting, Bal Harbour, Fla., 11–14 May 1964
(Contract NASw-451)

During simulated flight, performance and physiological response of 8 experienced jet pilots were measured and related to 2 aircraft speeds, 3 gust levels, and 2 types of terrain. Deviations from 500 ft (altitude errors) increased with increasing g, but pilots were able to maintain headings equally well under all experimental conditions. Breathing was faster at a gust level of 10 fps than at 2 fps, but no significant differences were found between 10 and 20 fps. No significant difference in heart rate was found, nor was fatigue important in error determination of flight up to 90 minutes. Pitch and altitude errors were reduced when the side-stick controller was substituted for the center-stick controller. Author

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-27883* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
A CRYOGENIC TEST-MASS SUSPENSION FOR A SENSITIVE ACCELEROMETER
Philip Kenyon Chapman (M.S. Thesis) Jun. 1964 91 p refs
(Grant NsG-254-62; Contract DSR-5007)
(NASA-CR-56887; TE-10) OTS: $8.60 ph

LLAMA (for Low-Level Acceleration Measurement Apparatus) is an investigation of techniques for the measurement of acceleration in the range below 10^{-6}g. The design choices for the various components of an experimental accelerometer are briefly outlined, the main emphasis being on methods of supporting the test mass. Factors affecting the design of a superconducting (Meissner effect) test-mass suspension are discussed in some detail, and the construction of a feasibility demonstration model is described. The results of tests of the experimental instrument are presented, the conclusion being that the system shows promise of quite exceptional sensitivity, which should be realized when the other components have been assembled. Finally, several modifications are suggested that may allow operation down to at least 10^{-10}g. Author

N64-27888* Johns Hopkins U., Baltimore, Md.
INSTRUMENTATION FOR FAR ULTRAVIOLET ROCKET SPECTROPHOTOMETRY Technical Report No. 3
William G. Fastie Aug. 1963 24 p
(Grant NsG-193-62)
(NASA-CR-56884) OTS: $2.60 ph

A flight spectrometer was developed and is described. It consists of an Elbert optical system that is capable of extremely high spectral resolution and high radiant throughout. The sensitivity of the instrument is discussed. The high-voltage device required to sensitize the photomultiplier tubes and the amplifiers, in order to convert the tube outputs to signals compatible with telemetry requirements, employs well-known transistor circuitry. Diagrams of the circuit for the high-voltage supply and of the amplifiers, and the electrical-wiring diagram for the battery power supply and for the detector housing are presented. The manner in which the battery power supply is mounted is also shown. R.T.K.

N64-27898* Texas Instruments, Inc., Dallas Apparatus Div.
JPL LOW-FIELD MAGNETOMETER Final Engineering Report
26 May 1964 77 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950355)
(NASA-CR-56557; Rept.-1-76208-1) OTS: $7.60 ph

Instrument characteristics—description and operating instructions, sensor, power supply; and electronics—general discussion of equipment, system analysis, and system errors are all aspects of the low-field magnetometer as discussed in this report. G.D.B.

N64-27907* Massachusetts Inst. of Tech., Cambridge Research Laboratory of Electronics
CODING COLOR PICTURES
Uri F. Gronemann (Ph.D. Thesis) 17 Jun. 1964 43 p refs
(Grants NsG-496; NIH MH-043737-04; NSF GP-2495; DA-SIG-36-039-61-G14; Contract DA-36-039-AMC-03200
(NASA-CR-58170; REE-TR-422) OTS: $4.60 ph.

A computer-simulation study of efficient coding for color pictures was undertaken. Two typical color transparencies were resolved into three primaries, sampled in a square array, and recorded digitally on magnetic tape. The computer program transformed these data into luminance and chrominance quantities, performed certain parameter modifications, reconverted them into primary-color quantities, and wrote then on an output tape. The parameters that were modified were the effective number of samples per picture and the number of quantum values each for the luminance and for

the chrominance. The output tape was played back through the recorder–reproducer to produce images of the coded pictures on the face of the cathode ray tube, which were photographed through appropriate filters on color film. The resultant transparencies were later viewed and compared by a number of observers to determine the absolute and relative quality with the various codes (as affected by the variously modified parameters). Also, a test was run with a large number of observers to determine the relative recognizability of objects in one of the pictures when variously coded in color or monochromatically. The results show that while the best monochromatic reproduction achievable in the experimental system requires a transmission rate of 5 bits per sample (with logarithmic quantization used), the best color reproduction in the same system (with the same luminance sample density) requires an average of 5.55 bits per sample. Author

N64-27910* Barnes Engineering Co., Stamford, Conn.
HORIZON SCANNER FOR VENUS AND MARS, BEC MODEL 13-170 Final Engineering Report
Daniel F. Stanfill and Jerome M. Pasternak Mar. 1964 56 p ref Prepared for JPL
(Contract NAS7-100; JPL-950016)
(NASA-CR-56511; BEC 4253) OTS: $5.60 ph

This engineering report is concerned principally with the design and performance of Model 13-170 Infrared Horizon Scanner, developed for use on flyby planetary probes to Mars and Venus. Fabrication assembly and test fixtures are also discussed. A schematic diagram of the horizon scanner is included. R.T.K.

N64-27915 Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif. Santa Barbara Lab.
THERMOLUMINESCENT DOSIMETER COMPUTER-INDICATOR SYSTEM, PHASES III AND IV Final Engineering Report, 15 Oct. 1962–29 Feb. 1964
31 Mar. 1964 35 p refs
(Contract NObsr-85506)
(S-248-R; AD-601323)

Based on the experimental models, 5 computer–indicators and 500 detectors were produced. Official designations given to these units are Computer Indicator, Radiac CP784 (XN-1)/PD and Detector, and Radiac DT-284 (XN-1)/PD. The production of the detectors involved the preparation of the thermoluminescent phosphor, the manufacture of the vacuum tube detectors, the digitally coded handles, locks, plastic tube bases and spacers, and the detector cases. A special plastic had to be selected for the tube bases and spacers when it was found that the standard type was unsatisfactory. The computer–indicators incorporated a new photomultiplier tube that increased the sensitivity over that obtained in the experimental model. Complete manufacturing drawings were made to produce the computer–indicator and detectors. Recommendations for future development include new techniques for scale changing in the computer–indicator, and all-metal design for the detector bases and spacers, and new methods for binding of the phosphor in the detector element. Author

N64-27921 United Research Services, Burlingame, Calif.
THE FEASIBILITY OF AERIAL PHOTOGRAPHIC DETECTION OF FALLOUT Final Report
Myron B. Hawkins 29 May 1964 47 p refs
(Contract OCD-PS-64-2)
(URS-640-4; AD-601215)

A preliminary study was conducted to determine the feasibility of detecting fallout deposits after a nuclear attack, using aerial photographs. The investigation included: (1) study of selected characteristics of fallout; (2) analysis of existing aerial photographs taken at nuclear tests; (3) investigation of the general capabilities of modern aerial reconnaissance techniques; (4) demonstration of the detectability of two types of synthetic fallout using aerial photographs; and (5) analysis of the potential of aerial reconnaissance for fallout detection. The principal conclusion on the basis of the photographic evidence was that a limited detection capability exists at present even under uncontrolled conditons. It was also concluded that the detection and identification capability can be improved by the development of photographic techniques that exploit the reflectance differences between fallout and various contrasting surfaces, and that the capability to quantify the fallout deposit mass by comparative means can be developed. Author

N64-27927 Joint Publications Research Service, Washington, D.C.
INSTRUMENTS AND APPARATUS FOR BIOLOGICAL INVESTIGATION AND MEDICAL DIAGNOSTICS
20 Aug. 1964 38 p refs Transl. into ENGLISH of the book "Peredovoy Nauchno-Tekhnicheskiy I Proizvodstvennyy Opyt," Moscow, 1962 p 1–24
(JPRS-26037; TT-64-41307) OTS: $2.00

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N64-28027 Weapons Research Establishment (Australia) Dept. of Supply
THE EVALUATION OF LONG FOCAL LENGTH OPTICAL SYSTEMS UNDER DIFFERENT ATMOSPHERIC "SEEING" CONDITIONS
F. A. Dixon Oct. 1963 23 p refs
(WRE-TN-ISD-39)

The effect of atmospheric "seeing" conditions on the quality of images produced by long focal length optical systems is studied. It is shown that if optical images are recorded under favorable "seeing" conditions, such as those known to prevail throughout the year at lines of sight above 15° elevation and at certain times of day during winter at lines of sight down to the horizontal, the optical system plays a major role in determining the overall image quality available from the system. It is also shown that when adverse "seeing" conditions prevail, such as those encountered in summer and at certain unfavorable periods in winter, in both cases at lines of sight near the horizontal, the lens has little or no influence on the overall image quality, the atmosphere alone dictating the performance of the system. Author

N64-28029 General Electric Co., Cincinnati, Ohio Advanced Technology Services
REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 83
31 Jul. 1964 22 p refs
(Contract AT(40-1)-2847)
(GEMP-83) OTS: $0.50

Progress is reported in the following areas: (1) capacitance temperature sensor development—high-temperature testing in nonoxidizing atmospheres and high-temperature system for oxidizing atmospheres; (2) high-temperature extension of conventional nuclear sensors; and (3) development of nuclear sensors—fail-safe shutdown channels, transistorized servo-drive amplifier, 60-cps control system simulation, high-temperature compensated chamber, and charged-fragment neutron detectors. R.T.K.

N64-28113 Michigan U., Ann Arbor Inst. of Science and Technology

ORTHOGONAL ULTRASONIC SIGNALS

E. E. Henry Apr. 1964 13 p refs

(Contracts DA-36-039-SC-78801; AF 33(616)-8365)

(Rept.-2900-444-R; AD-438035)

The modulator cell is mounted in an optical system with the light beam normal to the plane of the ultrasonic axes, so that the diffraction patterns produced as the crystals are energized, both singly and simultaneously, are visible. Amplitude modulation is introduced, as well as the pure resonant frequency wave. Studies, to date, of the optical effects indicate that the ultrasonic signals are orthogonal—i.e., free from frequency mixing—even when various modulations are used. Some difficulty was encountered with the separation of the electrical signals. This paper describes the equipment used and the results achieved with this equipment. Author

N64-28127 Weapons Research Establishment (Australia) Dept. of Supply

THE DESIGN OF A FLAT FIELD, WIDE ANGLE, LOW f-NUMBER REFLECTING TELESCOPE FOR USE IN THE 8 TO 14 MICRONS WAVELENGTH RANGE OF THE INFRARED REGION

B. Porter May 1964 28 p refs

(WRE-TN-CPD-79)

The optical system under investigation was intended for use in a thermal image converter. Preliminary experiments had indicated that some difficulty would be experienced in curving the screens to match the curved image field, produced by the twin mirrored system of Schwarzschild. It was decided that a lens must be used to flatten this field and simultaneously compensate for the resultant astigmatism. However, the insertion of such a component into the aplanatic mirror system would introduce spherical and coma aberrations, which would need to be balanced out by means of the adjustment of the mirror surface coefficients of z^4 and above. Any attempt to perform this analytically, even restricting attention to third-order aberration errors alone, would have been an extensive task. It was decided, therefore, to make use of the W.R.E. IBM 7090 Computer. Ray trace programs, designed to handle variations of all relevant parameters, were constructed and tested. This approach gave results that improved to a point where no further success by parameter adjustment seemed possible. Author

N64-28128 Weapons Research Establishment (Australia) Dept. of Supply

THE DESIGN OF A FIELD FLATTENING LENS FOR A PARTIALLY CORRECTED INFARED SCHMIDT SYSTEM

B. Porter May 1964 17 p refs

(WRE-TN-CPD-84)

An infrared Schmidt system to serve as the optical system in an early model thermal imaging device had an f/number of about 0.7, ignoring mirror reflection and transmission losses through the potassium bromide corrector plate. This system required modification for use as the optical system in the thermal image converter under development. No provision for a field flattening lens had been made. This note describes the work that had to be undertaken in order to design a field lens, whose insertion into the system would enable adequate resolution to be achieved over a flat image field for about 12° angular coverage. Author

N64-28134 Atomic Energy of Canada Ltd., Chalk River, Ontario

SOLID STATE FLOW MONITORING TRIP AND ALARM SYSTEM FOR THE NRU REACTOR

B. J. Reel Apr. 1964 18 p

(AECL-1974) Available from Sci. Doc. Distrib. Office, AEC, Chalk River, Ontario: $0.50

The rod cooling water flow is measured by a differential pressure cell connected to the input and output of each rod cooling system. The output of the dp cell is measured by means of a pneumatic pressure meter fitted with solid-state trip and alarm circuits. The outputs of the trip and alarm circuits are fed to separate logic gates; these operate trip and alarm relays when any one or more of the pressure measurements falls below preset levels. Author

N64-28175 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONTEMPORARY RADIO ELECTRONICS AND PROBLEMS OF MEDICINE AND BIOLOGY

V. G. Marvrodiadi and I. T. Akulinichev 23 Mar. 1964 18 p Transl. into ENGLISH from the book "Elektronika v Meditsine", Moscow, Gosenergizdat, 1960 p 38–50

(FTD-TT-63-1188/1+4; AD-437118)

This report presents reviews of the following areas: (1) special scientific instrumentation for biology; (2) radio-electronic apparatus for disease prevention; (3) diagnostic electronic apparatus; (4) therapeutic radio-electronic apparatus; (5) radio-electronic instruments for laboratory medical investigations; and (6) the use of radio electronics in prosthetics. It is indicated that, while there have been definite achievements in using radio electronics in public health, the introduction of electronics into medicine and biology, on the whole, has been unfavorable. Presently there is a gap between the potentials of electronics and their actual use in medicine and biology. To eliminate this gap, it is necessary to establish a better relationship between radio engineers and physicians. I.v.L

N64-28203* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SPECTROGRAPHIC MEASUREMENTS OF SOLAR SIMULATION SOURCES

In its Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 30 p (See N64-28201 20-23) OTS: $19.75 ph

Measurements of the spectral irradiance of several sources, and an evaluation of the methods and procedures for operating available spectrographic equipment are discussed. Three high-dispersion spectrographs were used in the study of spectral irradiance of high-energy sources—two were single-prism monochromators, and the third was a double-prism monochromator. Discussed in particular are the following: (1) wavelength calibration of spectrographs; (2) signal-strength calibrations; (3) secondary tungsten-ribbon standard lamps; (4) spectral irradiance of a mercury–xenon arc; and (5) spectral irradiance of a carbon arc. P.V.E

N64-28205* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CALIBRATION OF THERMOPILES
In its Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 11 p refs (See N64-28201 20-23) OTS: $19.75 ph

The calibration of an Eppley thermopile in the energy ranges needed for solar simulation is described. The Eppley thermopile is frequently used for monitoring the total energy incident on a surface. A calibration table for the thermopile is given. P.V.E.

N64-28206* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CALIBRATION OF THE FIVE-CHANNEL TIROS SATELLITE RADIOMETER
E. I. Mohr and F. J. Owens *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 14 p refs (See N64-28201 20-23) OTS: $19.75 ph

Channels 3 and 5 of the five-channel Tiros satellite radiometer were calibrated at the Goddard Space Flight Center, and this calibration seemed to be incorrect by a factor of 2. This report discusses a check on these calibrations. The check team used a series of intensities that produced output voltages ranging from 0.5 v to 11 v for both channels. A similar range of intensities was used to obtain output voltages varying from about 2 v to 10 v for channel 3 and about 1 v to 5 v for channel 5. A comparison of the results of the two methods of calibration shows that, for channel 3, an output of 10 v corresponds to an intensity of 224 w/m^2 in the Goddard calibration, and an intensity of 225 w/m^2 in the check team calibration. For channel 5, an output of 5 v corresponds to an intensity of 20.9 w/m^2 for Goddard and an intensity of 20.7 w/m^2 for the check team. In other words, the results obtained by the two methods of calibration are in agreement at the maximum value of the output voltages used in the Goddard calibration. However, the calibration curve for channel 3 shows that the slopes obtained by the two methods are somewhat different. The slope obtained at Goddard is 0.0423 $v/m^2/w$, and that obtained by the check team is 0.463 $v/m^2/w$. For channel 5, the slope obtained by Goddard is 0.228 $v/m^2/w$, whereas that of the curve obtained by the check team is 0.253 $v/m^2/w$. I.v.L.

N64-28208* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VACUUM GAUGE SYSTEMS
J. Gavis *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 12 p refs (See N64-28201 20-23) OTS: $19.75 ph

A distinction is made between absolute and relative pressure measurements in discussing calibration methods for high- and ultra-high-vacuum gages. The difficulties in obtaining known absolute pressures below 10^{-6} to 10^{-7} torr are enumerated, and various types of vacuum gages and the intricacies of their operation below this pressure range are outlined. A workable system for obtaining absolute pressures above 10^{-6} torr by a pressure-division method is described. The advantages of this method for calibrating vacuum gages are freedom from adsorption and the fact that the system does not have to be baked. The construction and operation of a workshop model of such a pressure-division calibration apparatus is discussed. M.P.G.

N64-28289 Princeton U., N.J.
AN ELECTRICALLY OPERATED MICROBALANCE AND AN OMNIDIRECTIONAL FORCE STANDARD
Robert O. Woods, (M.S. Thesis) 30 Sep. 1963 75 p refs (Grant NSF G-19087)

An instrument was developed capable of measuring forces on the order of 50 millidynes and compatible with the requirements of vacuum operation. The instrument has a freely rotating movable element for which a magnetic thrust bearing and vibrating radial bearings were developed. Null-point operation is achieved by opposing an unknown torque with one that is known and controllable. A convenient method of exerting such torque is described. A secondary standard capable of applying a calibrating force in any direction has been developed, utilizing the force exerted by a small air jet. Information is provided regarding use of such jets, including use as primary force standards with accuracy on the order of 95%. Author

N64-28299* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALORIMETRIC HEATING-RATE PROBE FOR MAXIMUM-RESPONSE-TIME INTERVAL
Robert H. Kirchhoff Repr. from AIAA Journal, May 1964 1p (NASA-RP-238)

A desirable feature of calorimetric probes for very high heating-rate environments is the longest possible interval of linear temperature–time response. This report indicates a mathematical design for a calorimetric probe that will maximize the time interval of linear response. The frontal area of the calorimetric slug of this aerodynamic-heating probe is small enough so that only stagnation-point heat transfer is measured. The probe is considered to be a finite slab of material with a uniform heating rate at the front face and to be insulated on the sides and at the back face, thus reducing the problem to one-dimensional heat conduction. I.v.L.

N64-28315* Astro Research Corp., Santa Barbara, Calif.
BORON FILAMENTS
Robert M. Witucki Washington, NASA, Sep. 1964 21 p refs (Contract NASw-652)
(NASA-CR-96) OTS: $0.50

Filaments made by depositing elemental boron on tungsten wire are under considerable internal strain. This effect arises from expansion of the tungsten lattice as boron is introduced. This effect causes spiral cracks, as well as the radial cracks that develop on grinding end sections. Since the filaments are formed at a high temperature, a differential thermal expansion between the tungsten boride core and the boron sheath can cause significant stresses to develop on cooling. Author

N64-28352* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIBRATING MEMBRANE ELECTROMETER WITH HIGH CONVERSION GAIN
John Dimeff and James W. Lane Repr. from The Rev. of Sci. Instr., v. 35, no. 6, Jun. 1964 p 666–668 refs
(NASA-RP-289)

A vibrating membrane transducer is used as the sensing element for a high sensitivity electrometer. The method of operation provides an increased conversion gain by using a special circuit in which the electrometer current controls the displacement amplitude of a membrane forced to vibrate at its resonant frequency. The experimental transducer produces an

alternating output voltage, is small and rugged, and has a conversion gain three orders of magnitude greater than electrometer transducers in current use. Author

N64-28398 Joint Publications Research Service, Washington, D.C.
TELEMETERING OF RADIOACTIVE RADIATIONS
A. A. Bragin and V. N. Mikhaylovskiy 24 Aug. 1964 9 p Transl. into ENGLISH of the introduction and table of contents from the book "Teleizmereniye Radioaktivnykh Uzlucheniy" Kiev, 1963 p 3–6, 155–156
(JPRS-26100; TT-64-41360) OTS: $1.00

This document consists of the introduction and table of contents of a book entitled "Telemetering of Radioactive Radiation." The introduction cites various types of radiometric well apparatus in use, and refers to the search for possibilities of a combined system of measurements—the devising of the most efficient complexes of simultaneously measurable parameters and the development of methods and means of setting up multichannel telemetric systems for geophysical investigations of oil and gas wells. The table of contents includes the following: (1) statistics of readings and statistical errors; (2) the effectiveness of detector transmission; (3) apparatus errors and methods of reducing them; (4) the distributions of channels; (5) thermostatic scintillating counters; and (6) telemetering devices for investigating radioactive radiation in wells. I.v.L.

N64-28400 Joint Publications Research Service, Washington, D.C.
NEW MODIFICATION OF A METHOD FOR RECORDING SKELETAL AND SMOOTH MUSCLE CONTRACTIONS WITH A SMALL CAPACITY PICKUP UNIT
L. M. Tolstykh-Chernitskaya and Yu. V. Gur'yanov 8 Sep. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk BSSR (Minsk), v. 7, no. 6, 1963 p 422–424
(JPRS-26307; TT-64-41566) OTS: $1.00

The method described in this report is based on the use of a capacitance pickup unit that is an indicator of muscular contraction. The pickup consists of a capacitor with thin metallic plates that, when shifted in relation to each other, alters its capacitance. The shift of the pickup plates occurs as the result of mechanical action by the thickened muscle (or group of muscles) when it contracts, or as a result of change in the size of a hollow organ. The conversion of capacitance changes into electric signals is carried out by a PIMEL instrument. A type EKPS-1 electrocardiograph was used as the recording instrument, although any currently existing oscillograph may be used. The use of the capacitance pickup, in addition to allowing the realization of the simultaneous (parallel) recording of the electromyogram and the mechanogram of muscular contraction, permits very accurate determination of the beginning of contraction, i.e., the estimation of the latency period; the duration of contraction; amplitude; and frequency, etc. In addition, changes in blood pressure can be recorded with the pickup. I.v.L.

N64-28426 Joint Publications Research Service, Washington, D.C.
EQUIPMENT FOR NEUROPHYSIOLOGICAL INVESTIGATIONS
9 Sep. 1964 48 p refs Transl. into ENGLISH from Peredovoy Nauch.-Tekhn. i Proizv. Opyt., Pribory i App. dlya Biol. Issled. i Med. Diagnostiki (Moscow), no. 4, 1962 28 p
(JPRS-26316; TT-64-41575) OTS: $2.00

CONTENTS:
1. TWO-CHANNEL INSTALLATION UNI-1 FOR NEUROPHYSIOLOGICAL INVESTIGATIONS L. S. Sedlovich and R. M. Meshcherskiy p 1–22
2. TWO-CHANNEL ELECTROENCEPHALOGRAPH EECHS-1 FOR DETERMINATION OF DEPTH OF NARCOSIS N. E. Rabinovich p 23–31
3. APPARATUS FOR AUTOMATIC COUNTING OF ERYTHROCYTES AND LEUCOCYTES N. M. Florianovich p 32–43 refs

N64-28548 Santa Barbara Research Center, Goleta, Calif.
PRODUCTION ENGINEERING MEASURE PbSe INFRARED DETECTOR–TYPE IR-200 Quarterly Progress, 1 Apr.–1 Jul. 1964
G. H. Cook 25 Aug. 1964 33 p
(Contract DA-36-039-AMC-01466(K))
(QPR-6; AD-604186)

Testing of the 39 PbSe IR detector samples, Type IR-200, was completed. Test data are presented in tabular form. Of the 39 detectors, 12 met the performance requirements. The engineering drawings were revised to allow the use of the 0.040-in.-thick sapphire window. Also, the Dewar OD tolerance was increased. I.v.L.

N64-28553 Innsbruck U. (Austria)
FIELD STRENGTH METER FOR VLF WAVES Scientific Report No. 8
Wolfram Bitterlich 1 Apr. 1964 19 p
(Contract AF 61(052)-490)
(AFCRL-64-479; AD-603048)

A small, easily portable nuvistorized field-strength meter for the frequency range of 1.9 to 25 kc/s is described. The antenna consists of a ferrite rod, approximately 1-m long, covered with metal windings. Special attention was paid to a high sensitivity at a large signal-to-noise ratio. Author

N64-28691 Philco Corp., Lansdale, Pa. Lansdale Div.
PEM FOR GOLD-DOPED GERMANIUM INFRARED DETECTOR TYPE IR400 Quarterly Progress Report, 27 Dec. 1963–27 Mar. 1964
A. Guimento [1964] 65 p
(Contract DA-36-039-AMC-01464(E))
(QPR-5; AD-602213)

Work was concentrated on fabricating and testing six engineering samples that had barium fluoride windows and sensitive areas 1/2 mm × 1/2 mm. The change in sensitive area from 2 mm × 2 mm required additional engineering effort beyond that completed under the original provisions of the contract. Work was continued on the inspection and quality control plan and the equipment requirements and production rates data. The preproduction phase of the contract was started during this period. Considerable effort was expended on improvement of existing tooling to be used with an optical comparator to assure proper alignment of the cell. Detailed test data on the six engineering samples delivered are included. Author

N64-28708 David Taylor Model Basin, Washington, D.C. Hydromechanics Lab.
RECENT ADVANCES IN THE MEASUREMENT OF STRUCTURAL IMPEDANCE
Fred Schloss Jan. 1963 43 p refs
(DTMB-1584; AD-295856)

Two devices for measuring mechanical impedance were developed, one for heavy structures capable of measuring a stiffness of 140 × 10^6 lb/in. over the frequency range of 5 to 4,000 cps and the other for lighter structures capable of measuring a stiffness of 5 × 10^6 lb/in. over the frequency range of 20 to 8,000 cps. Phase angles were measured in the presence of noncorrelated vibrational and electrical noise and distortion. Each device used two piezoelectric ceramics to sense the applied force and the acceleration response of the structure. The mass associated with the coupling between the impedance transducer and the structure was cancelled electronically. Novel details of the design are presented, such as the elimination of magnetic pickup by the piezoelectric transducers and the reduction of mechanical crosstalk. Manual and automatic phase and impedance measuring systems having a high degree of accuracy are discussed. The report includes procedures for determining the acoustic sensitivity, transverse sensitivity, rocking sensitivity, and strain sensitivity of accelerometers. Practical considerations for making mechanical impedance measurements are also included. Author

N64-28718 Weapons Research Establishment (Australia) Dept. of Supply
AN INDUCED CURRENT DETECTOR FOR MISSILE FIRING CIRCUITS
D. W. Willshire and T. J. Schultz Dec. 1962 18 p
(WRE-TN-EID-56)

A description is given of an instrument for measuring the rms current in the electric fuse igniters used to initiate explosives. This enables an assessment to be made of the hazards arising from electromagnetic radiation inducing currents in firing circuits. The instrument uses an indirect method of measurement, which is more reliable and without the defects of the direct methods previously used. Small thermistor beads are used to measure the temperature rise of the fuse wire.
Author

N64-28730 Weapons Research Establishment (Australia) Dept. of Supply
RADIAL DISTORTION CALIBRATION OF BALLISTIC CAMERAS
G. W. Mc Quistan Apr. 1963 17 p refs
(WRE-TN-OID-34)

Calibration of the symmetrical radial distortion of ballistic cameras by the use of star calibrations and goniometer measures are outlined and compared. Estimates are obtained of the accuracy of such calibrations. Consideration is given to ways in which unsymmetrical radial distortion might be calibrated.
Author

N64-28731 Weapons Research Establishment (Australia) Dept. of Supply
FLIGHT TRIAL RESULTS FROM A FOUR COMPONENT BALANCE AND OTHER AIRBORNE INSTRUMENTATION INCLUDED IN A SUPERSONIC MISSILE WITH CRUCIFORM RECTANGULAR WINGS
G. J. Simpson Feb. 1962 29 p refs
(WRE-TN-SAD-88)

This note gives the results from a flight trial of a four-component strain-gage balance measuring lift, drag, pitching, and rolling moments acting on one wing pair of a cruciform winged body during induced pitching oscillations. The parameters Z_w and center of pressure for the overall vehicle were determined and compared with results from previous firings of identical wing body rounds. A comparison is also made of the performance of a number of standard types of accelerometer included in the vehicle. Author

N64-28736* Consolidated Controls Corp., Bethel, Conn.
PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES First Quarterly Report, Feb. 27–May 31, 1964
R. E. Engdahl, ed. 2 Jul. 1964 86 p refs
(Contract NAS3-4170)
(NASA-CR-54140; CCC-425) OTS: $8.10 ph

Development of a series of pressure transducers for liquid metals is described. Environmental conditions include operation to 1,800° F with metals such as mercury, sodium, and potassium. The systems are being designed as flight or ground test instruments. The design and material selection of the pressure-deflection system together with the electrical terminal arrangement is established. An analysis of the electrical measurement systems under consideration is presented. The facilities for conducting the test program are also described. Author

N64-28779 California U., Berkeley Lawrence Radiation Lab.
CONSTRUCTION AND CALIBRATION OF THE SCANNING AND MEASURING PROJECTOR
P. G. Davey and A. J. Schwemin 22 Apr. 1964 43 p refs
(Contract W-7405-ENG-48)
(UCRL-11372) OTS: $1.00

The scanning and measuring projector is a data-reduction system that digitizes coordinates of particle tracks in bubble-chamber film, and processes them through an on-line digital computer program to provide information about the nature of the particles in a form useful to the physicist. The report gives a detailed account of the construction and calibration of the hardware associated with the SMP. The complete system digitizes with a positional accuracy of about 3 in 10^5 in a projected field of 50 × 70 cm. Author

N64-28796 Harry Diamond Labs., Washington, D.C.
ANALYSIS OF THE SPIRAL ANTENNA DIRECTION FINDER
Peter B. Johnson 20 Apr. 1964 38 p refs
(HDL-TR-1221; AD-601733)

A study was made of a method previously suggested for constructing a passive direction finder capable of determining the azimuth and elevation of an electromagnetic wavefront. This direction finder consists of a two-wire, Archimedian, spiral antenna and a phase comparator. Angular information of accuracy too low for the intended application is obtained when the theory and experimental data previously presented are used. A general theory for the direction finder is established, and methods for accuracy improvement are suggested. Author

N64-28809 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Chemistry Div.
APPARATUS FOR THE MEASUREMENT OF VAPOUR PRESSURES OF AQUEOUS SOLUTIONS AT HIGH TEMPERATURES
H. J. de Nordwall and P. J. Jones Jul. 1963 52 p refs
(AERE-R-3565, Rev.) HMSO: 8 s

An apparatus for measuring the vapor pressure lowering of aqueous solutions in the temperature range 100° to 250° C is described. A brief review of methods of measuring pressure differences in chemical systems is given as an introduction to the description of the apparatus. Author

N64-28836* Maryland U., College Park Computer Science Center
PATTERN RECOGNITION: II. RAMP AND REST TWO IMAGE ANALYSIS PROGRAMS
James N. Orton and Azriel Rosenfeld Aug. 1964 90 p refs
(Grant NsG-398)
(NASA-CR-58608; TR-6410) OTS: $8.10 ph

This report presents detailed descriptions of two basic computer programs for the analysis of the connectivities and shapes of regions in digitized images. The application of these programs to the analysis of TIROS cloud cover pictures and outline maps made from such pictures is also briefly described. The programs are written in FAP and have been extensively tested on the 7090. Author

N64-28856* Southwest Center for Advanced Studies, Dallas, Tex.
AN INSTRUMENT FOR MEASURING ION COMPOSITION OF THE UPPER ATMOSPHERE
Thomas W. Flowerday Repr. from IEEE Trans. Instrumentation Meas., v. IM-13, no. 1, Mar. 1964 p 14–17 refs
(Grant NsG-269)

An instrument that is well suited for use in rocket and satellite work and is capable of measuring the ion composition of the upper atmosphere is described. The theory of operation of a Paul-type mass spectrometer is presented. A system consisting of a Paul mass spectrometer and an electron-multiplier-type detector, capable of measuring ion composition, is then described. The electronic system, which produces the RF and d.c. potentials required by the Paul mass spectrometer and which measures the current output of the electron multiplier is described. Author

N64-28858 Aktiebolaget Atomenergi, Stockholm (Sweden)
A NEUTRON REM COUNTER
I. O. Andersson and J. Braun Jan. 1964 22 p refs
(AE-132) Available from Aktiebolaget Atomenergi: 8 Sw. Kr.

A neutron detector is described that measures the neutron dose rate in rem/h independently of the energy of the neutrons from thermal to 15 Mev. The detector consists of a BF_3 proportional counter surrounded by a shield made of polyethylene and boron plastic that gives the appropriate amount of moderation and absorption to the impinging neutrons to obtain rem response. Two different versions have been developed. One model can utilize standard BF counters and is suitable for use in installed monitors around reactors and accelerators, and the other model is specially designed for use in a portable survey instrument. The neutron rem counter for portable instruments has a sensitivity of 2.4 cps/mrem/h and is essentially nondirectional in response. With correct bias setting the counter is insensitive to gamma exposure up to 200 r/h from Co^{60}. Author

N64-28869 Naval Boiler and Turbine Lab., Philadelphia, Pa
INSTRUMENT STANDARDS
E. L. Lewis, ed. 1 Jun. 1964 296 p 11th ed.
(AD-602036)

Material specifications and instrument test-measurement standards for repetitive items in use at the Naval Boiler and Turbine Laboratory are contained in this volume. Such items as thermocouples and thermocouple materials, strain gages, manometers, pressure recorders, calorimeters, piping, connectors, and insulators are included. Instrument standard involving flow measurements have been issued in a separate volume. D.S.G.

N64-28910 Naval Air Development Center, Johnsville, Pa. Aeronautical Electronic and Electrical Lab.
A GAMMA GUIDANCE SYSTEM FOR HELICOPTER FLIGHT-FORMATION CONTROL
George E. Wilcox 26 Mar. 1963 22 p
(NADC-EL-N6301; AD-400570)

Preliminary studies confirm the feasibility of using gamma radiation as the sensing signal for an all-weather, short-range, stationkeeping, formation-control system for helicopters. This report discusses three methods investigated for determining range, azimuth, and elevation. The eclipse method, which uses the difference signal between an unshielded and a shielded detector, was found to be capable of providing an accuracy of ±10% in range and ±1° in azimuth and elevation. Author

N64-28925* Barnes Engineering Co., Stamford, Conn.
MODIFICATION OF RADIOMETER TYPE THERMISTOR DETECTORS Final Progress Report
[1964] 34 p
(Contract NAS5-3320)
(NASA-CR-60003)

This report describes the development of techniques for the application of a global silicon carbide black material to unimmersed TIROS radiometer-type infrared detectors. The amount (mass/unit area) of this material required to optimize detector performance has been determined. Performance tests taken on detectors blackened with this material are compared with tests taken on similar detectors that utilize the standard Zapon black material. In all cases the global silicon carbide black material is shown to be superior to the Zapon. The effects on these detector characteristics due to vibration and exposure to ultraviolet radiation are also discussed. Author

N64-28959* Lockheed-California Co., Burbank
THE EFFECT OF NON-STANDARD APPROACH SECTIONS ON ORIFICES AND VENTURI METERS
P. S. Starrett and P. F. Halfpenny 12 Jun. 1964 62 p refs
(Contract NAS8-11011)
(NASA-CR-58549; LR-17905) OTS: $6.60 ph

A literature search was made in an attempt to establish guideline recommendations for the use of flow meters in nonstandard installations where upstream conditions result in velocity profiles that are decidedly different from standard. Theoretical expressions are available for computing the meter discharge coefficient as a function of the upstream velocity profile but, since the velocity profiles are seldom known in practice, the usefulness of such expressions is limited. Further, a particular type of disturbance may raise the coefficient of one meter while lowering the coefficient of another. Straightening vanes properly installed can be very effective, but improperly designed vanes magnify the existing deviations. In a few applicable cases, the probably deviations of Herschel-type venturi meters and orifice meters may be estimated on the basis of data presented in this report, but in-place calibration is the most acceptable approach to obtaining metering accuracy for many nonstandard installations. M.P.G.

N64-28966* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THERMAL CONDUCTIVITY AND RADIANT ENERGY TRANSPORT APPARATUS FOR NONELECTRICAL CONDUCTORS TO 2000°C
Martin H. Leipold 1 Jun. 1964 13 p refs
(Contract NAS7-100)
(NASA-CR-58132; JPL-TR-32-559) OTS: $1.60 ph

An apparatus for measuring the thermal conductivity of nonelectrical conductors to approximately 2,000° C is described. A direct measurement technique is employed, with radial heat directed through a thick-walled cylinder. Heat is applied at the center of the cylinder by means of a refractory metal heater. The temperature gradient is measured in a series of longitudinal holes, located at varying distances from the center of the specimen. An error analysis has been conducted for random errors, which indicates precision to be between ±5 and ±10%. Systematic errors are also discussed. The apparatus has been in operation for over a year, and approximately 150 runs have been completed. Results agree with published values for materials investigated, and the nature of the high-temperature anamolous behavior is under analysis. Author

N64-28989* Cornell U., Ithaca, N.Y. Radiophysics and Space Research Center

MANUAL FOR FLUXGATE FERRITE MAGNETOMETER

Jun. 1964 22 p refs

(Contract NASr-46)

(NASA-CR-58342; CRSR-172) OTS: $2.60 ph

The ferrite tubular fluxgate magnetometer is essentially an ambient magnetic field chopper, sensitive to the surrounding field component parallel to its axis. The tubular sensor represents an effort to decrease core losses by reducing core volume. This report describes the design and operation of the circuitry. It discusses the advantages and limitations of these magnetometers, parametric amplification in the tubular toroidally wound sensor, and demodulation. It describes the signal amplifier, the 10-kc signal filter, the 10-kc signal amplifier, and the negative feedback. I.v.L.

N64-28991* Cornell U., Ithaca, N.Y. Radiophysics and Space Research Center

FOUR FERRITE CORE MAGNETOMETERS Final Status Report, Oct. 1, 1963–May 15, 1964

T. Gold Jul. 1964 6 p refs

(Contract NASr-46)

(NASA-CR-58344; CRSR-174) ORS: $1.10 ph

Four single component magnetometers have been made using a new drive design with lowered even harmonic contamination. Their drift and noise is within ±0.3γ (±3 microgauss) or better, with a ±1.5-v analog readout range. Input power requirements have been reduced from 1.5 w in previous models to 0.58 to 0.9 w at 20- to 25-v d.c. input. At close to zero, field sensitivity is 0.2 to 0.5 mv per ambient gamma. Probing of the circuitry is facilitated by the spreading out of component parts. Thus, not being potted, the models as completed require some care in handling. I.v.L.

N64-29006* Jet Propulsion Lab., Calif. Inst of Tech., Pasadena.

A MOMENTUM-BALANCE METHOD FOR MEASURING THE THICKNESS OF FREE LIQUID SHEETS

George I. Jaivin 17 Aug. 1964 19 p refs

(Contract NAS7-100)

(NASA-CR-58246; JPL-TR-32-635) OTS: $1.60 ph

A method is presented for determining experimentally the momentum-averaged thickness of free liquid sheets. The technique requires the experimental determination of the reaction force produced by a sector of a liquid sheet upon a deflection plate placed in its path. This measurement, together with a weight flow rate, is used to calculate the local thickness and average velocity of the sheet by simultaneous solution of the applicable momentum and flow continuity relations. Details of the experimental apparatus are presented, and the results obtained when the apparatus was used to evaluate an axially symmetric laminar liquid sheet are given. Author

N64-29007 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

TOTAL RADIATION HEAT TRANSFER GAGE FOR HYPERVELOCITY SHOCK TUBE EXPERIMENTS

George M. Thomas and Wesley A. Menard 1 Aug. 1964 19 p refs

(Contract NAS7-100)

(NASA-CR-58668; JPL-TR-32-636) OTS: $1.60 ph

A heat-transfer gage was developed for measuring the total radiation from shock-heated gases in the spectral region from 0.2μ to 2.7μ. The gage consists essentially of a thin-film platinum resistance gage coated with a thin carbon film. The requirements for the use of the gage in shock-tube experiments are that the absorptance of the carbon film on platinum substrate be essentially constant over the spectral region of interest, and that the response time of the gage be of the order of 1μsec. This report describes the theory of operation and the technique of preparing the gages. Measurements of the reflectance of multilayer carbon films are presented. The methods of calibrating the gage and of relating the gage response to the radiance of the radiation source are described in detail. Finally, preliminary shock-tube measurements are made using the total radiation gage. These are found to be in good agreement with both theory and experiment. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-27890* Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center

INFLUENCE OF STRONG MAGNETIC FIELDS ON THE ELECTROCARDIOGRAM OF SQUIRREL MONKEYS (*SAIMIRI SCIUREUS*)

Dietkich E. Beischer and James C. Knepton, Jr. 13 Mar. 1964 26 p refs

(NASA Order R-39)

(NASA-CR-56886; BUMED-8) OTS: $2.60 ph

Man may be exposed to strong magnetic fields over prolonged periods of time if plans to apply such fields for reasons of a technical nature in future spaceships are realized. Experiments with subhuman primates are necessary in preparation for systematic investigation of possible effects of such fields on man. A study of the performance of the heart in a strong magnetic field is of special interest. Electrocardiograms of four monkeys were recorded during exposure of the animals to magnetic fields of 20,000 to 70,000 gauss. Neither breathing rate nor R wave amplitude of the ECG was affected. A decrease in the heart rate, an increase in the degree of sinus arrhythmia, and a considerable augmentation of the amplitude of the T wave are newly observed biomagnetic effects. The influence of strong magnetic fields on electrical processes in living matter is stressed. Author

N64-27891* Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center
USE OF CALORIC TEST IN EVALUATING THE EFFECTS OF GRAVITY ON CUPULA DISPLACEMENT
Michael E. Mc Leod and Manning J. Correia 2 Apr. 1964 14 p refs
(NASA Order R-93)
(NASA-CR-56791; BUMED-94) OTS: $1.60 ph

This study was carried out to evaluate the effect of gravity on cupula displacement. The results do not support the hypothesis that the cupula responds to linear acceleration (gravity) if it is assumed that the cupula is heavier than the surrounding endolymph. Author

N64-27953 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
PATHOPHYSIOLOGY OF PULMONIC TOXICITY IN RATS EXPOSED TO 100 PER CENT OXYGEN AT REDUCED PRESSURES
Kenneth H. Dickerson 5 May 1964 85 p refs
(NADC-ML-6403; AD-601331)

A life support system for exposing experimental animals to artificial atmospheres is described. This system was used to subject mature, male, Caesarean-delivered, albino rats to essentially 100% oxygen at pressures of 725-, 650-, 550-, and 250-mm Hg. The environmental variables of temperature, pressure, relative humidity, P_{CO_2}, and P_{O_2} were controlled within certain desired limits. The purpose of the oxygen exposures was to determine the hazard to rats of breathing pure oxygen at pressures of less than one atmosphere, for prolonged time periods. After exposure the dead and surviving animals were examined grossly and microscopically for pulmonary damage. The survival time of rats appears to be inversely related to the oxygen partial pressure. Their survival time begins to be appreciably lengthened at a pressure lying somewhere between 550- and 650-mm Hg. Author

N64-27954 Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
OBSERVATIONS ON ACUTE AND CHRONIC OXYGEN POISONING
George H. Kydd 21 Apr. 1964 15 p refs
(NADC-MA-6331; AD-600773)

In an effort to discover the relationship between the occurrence of convulsions (acute effects) caused by oxygen at high pressure (OHP), and paralysis (chronic effects), susceptible rats were repeatedly exposed to OHP under conditions that lessened the tendency toward the occurrence of convulsions. One group was lightly anaesthetized (10 mg/kg Nembutal), and the other was exposed for a short time to maximum pressure, then slowly decompressed. Of the anaesthetized animals, two developed paralysis without having exhibited any previous acute (convulsive) effects, while four developed paralysis with only slight acute effects. All of the slowly decompressed rats convulsed but only two showed paralysis. These observations indicate that paralysis and convulsions are not necessarily associated symptoms of oxygen toxicity. Author

N64-27968* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
RESPONSES OF SINGLE UNITS IN THE AUDITORY CORTEX
G. L. Gerstein and N. Y-s. Kiang Repr. from Exptl. Neurol., v. 10, no. 1, Jul. 1964 p 1–18 refs
(Grants NsG-496; NSF G-16526; NIH G-MH-04737-03; NIH G-B-1344)

The temporal firing patterns of units in the auditory cortex were studied as a function of stimulus parameters. Different units exhibit a wide variety of response patterns for the same stimulus. A particular unit may exhibit different response patterns to different stimuli. Units do not seem to show laminar or columnar organization with respect to temporal response pattern. However, tonotopic organization of the cortex may be reflected in the arrangement of columns, where each column is maximally sensitive to a particular frequency. Author

N64-28007 Joint Publications Research Service, Washington, D.C.
GEOBOTANICAL MAPPING
V. B. Sochava and T. I. Isachenko, ed. 6 Jul. 1964 118 p refs
Transl. into ENGLISH of the book "Geobotanicheskoye Kartografirovaniye", Moscow, Izd. Akad. Nauk SSSR, 1963 p 3-72
(JPRS-25347; TT-64-31620) OTS: $2.50

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4. RECOGNITION AND MAPPING OF FIRES THAT TOOK PLACE AT DIFFERENT PERIODS OF TIME WITH THE PURPOSE OF DETERMINING THE DYNAMICS OF THE TAYGA VEGETATION A. S. Karpenko and Yu. O. Medvedev p 38–46 refs
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N64-28009 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM "NAUKA I ZHIZN" (SCIENCE AND LIFE), VOLUME XXX, NO. 2, 1964
17 Jul. 1964 183 p Transl. into ENGLISH from a RUSSIAN Periodical
(JPRS-25506; TT-64-31778) OTS: $3.00

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N64-28034 Joint Publications Research Service, Washington, D.C.

SOVIET RESEARCH IN BIOPHYSICS

30 Jul. 1964 151 p refs Transl. into ENGLISH from Biofizika (Moscow), Vol. IX, no. 2, 1964
(JPRS-25652; TT-64-31924) OTS: $4.00

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8. ANIONS AND THE WORK OF EXCITABLE TISSUES L. M. Tsofin and Ye. A. Liberman p 110–144 (See N64-28040 20-16)

N64-28035 Joint Publications Research Service, Washington, D.C.

TAUTOMER TRANSFORMATIONS IN NUCLEIC ACID COMPONENTS AND THEIR ROLE IN MUTAGENESIS

B. I. Sukhorukov and V. I. Poltev *In its* Soviet Res. in Biophys. 30 Jul. 1964 p 1–23 (See N64-28034 20-16) OTS: $4.00

The results of theoretical consideration between thermodynamic functions of tautomer equilibrium and quantum-chemical parameters of molecules are applied to a study of tautomer transformations of nucleic acid components and a clarification of the biological role of their tautomer structures. An appraisal of the changes of enthalpies and tautomer quilibrium constants of nitrous bases is given. R.T.K.

N64-28036 Joint Publications Research Service, Washington, D.C.

INVESTIGATION BY VAPOR FLOW METHOD OF APPEARANCE AND DESTRUCTION OF SEMIQUINONE FREE RADICALS IN SYSTEMS MODELLING BIOLOGICAL OXIDATION

I. G. Kharitonenkov, A. E. Kalmanson, A. G. Chetverikov, and L. A. Blyumenfeld *In its* Soviet Res. in Biophys. 30 Jul. 1964 p 24–38 (See N64-28034 20-16) OTS: $4.00

The following substances were investigated while forming during step-wise oxidation or restoration of semiquinone free radicals: n-benzoquinone, ethylhallate, menadione (water soluble bisulfide derivative of vitamin K), methinone (water insoluble vitamin K), and flavones (rutin and quercetin). The substances were investigated by EPR and by vapor flow methods (VFM), and the results are discussed in detail. R.T.K.

N64-28038 Joint Publications Research Service, Washington, D.C.
THE NATURE AND MECHANISM OF NEURON DISCHARGE
V. V. Dubikaytis and Yu. V. Dubikaytis *In its* Soviet Res. in Biophys. 30 Jul. 1964 p 48–63 refs (See N64-28034 20-16) OTS: $4.00

An attempt is made to determine the mechanism of ionic exchange of K and Na and the actual nature of neuron discharge, on the bases of the calculation of peculiarities in the change of aqueous cytoplasmic structure and the properties of nucleoproteins at different functional states of the neuron. R.T.K.

N64-28039 Joint Publications Research Service, Washington, D.C.
COORDINATE STRUCTURE OF HUMAN BALLISTIC MOVEMENT AND QUESTIONS OF ITS CENTRAL REGULATION
L. V. Chkhaidze *In its* Soviet Res. Biophys. 30 Jul. 1964 p 97–109 refs (See N64-28034 20-16) OTS: $4.00

A review of investigations of the ballistic movements of the lower limbs and, to a lesser extent, the upper limbs of man is presented. The ballistic movements are considered those that consist of three phases—swing, blow, and post-blow braking of the kinesthetic "links" executing this movement. The first two phases are discussed since the quality of fulfillment of a ballistic movement is connected only with these phases. Evidence is presented indicating that the brain controls the flow of the basic phase of ballistic movements. R.T.K.

N64-28040 Joint Publications Research Service, Washington, D.C.
ANIONS AND THE WORK OF EXCITABLE TISSUES
L. M. Tsofin and Ye. A. Liberman *In its* Soviet Res. in Biophys. 30 Jul. 1964 p 110–144 (See N64-28034 20-16) OTS: $4.00

This survey article covers the following topics that are related to the participation of anions in the function of excitable tissues: distribution of anions between cell and medium; membrane Cl^- distribution theory; influence of change of Cl concentration on rest potential and resistance of muscle fiber membranes; mechanism of Cl distribution as postulated by the phase-membrane theory; the role of Cl in action potential generation; and the influence of Cl ion replacement in solutions on the mechanical response of skeletal muscles. R.T.K.

N64-28050 Joint Publications Research Service, Washington, D.C.
THE POSSIBLE AND IMPOSSIBLE IN CYBERNETICS
A. Berg and E. Kol'man, ed. 1 Sep. 1964 218 p Transl. into ENGLISH of the book "Vozmozhnoye i Nevozmozhnoye v Kibernetike" Moscow, Izd. Akad Nauk SSSR, 1963 p 1–222 (JPRS-26201; TT-64-41460) OTS: $6.00

This is a compilation of articles on cybernetics by Soviet and other scientists and writers. Subjects included those on automatic thinking machines, life, and sense; the ability of a machine to possess psychology; living creatures and the cybernetics device; and cybernetics and creative work. G.D.B.

N64-28062 Joint Publications Research Service, Washington, D.C.
RADIOELECTRICS IN SPACE MEDICINE
I. T. Akulinichev, R. M. Bayevskiy, K. P. Zazykin, and V. R. Freydel' 24 Aug. 1964 53 p refs Transl. into ENGLISH from Pamphlet "Massovaya Radiobiblioteka," Moscow, No. 505, 1964 (JPRS-26081; TT-64-41351) OTS: $3.00

Soviet experiments in space medicine are reviewed briefly. The following are discussed in detail: (1) collection and conversion of medicobiological information; (2) medical radioelectronic equipment used on Soviet earth satellites and space ships; (3) systems of transmission and recording of data; (4) application of radio communication and television in medical control; and (5) application of radioelectronics in space medicine. E.K.R.

N64-28076 Joint Publications Research Service, Washington, D.C.
OXYGEN DEFICIENCY
A. F. Makarchenko 10 Aug. 1964 101 p refs Transl. into ENGLISH from the book "Kislorodnaya Nedostatochnost," Kiev, Publ. House of the Academy of Sci., Ukrainian SSR, 1963 p 2-13, 571–610
(JPRS-25796; TT-64-41067) OTS: $3.00

Results are presented of investigations of leading Soviet laboratories that are resolving the problem of hypoxia and the organism's adaption to it. In particular, questions of the comparative physiology of adaption and acclimatization of the organism to Alpine climates are discussed; contemporary concepts of the significance of cellular chemism in the process of adaption to hypoxia are presented; and material concerning the significance of hypoxemia in the pathologies of childhood and the age factor in the reaction of the organism to hypoxia are cited. New facts about the influence of hypoxia on the distribution of stimuli in the motor zones of the brain, its influence on bioelectric activity, oxygen tension, and energy indices of the cerebral cortex and the subcortical layer are reported. The problem of regional oxygen deficiency and the significance of the latter in the development of myocardial in infarction are examined. Also discussed are questions on oxygen starvation and the mechanisms of compensation to it during cardiac insufficiencies. Questions concerning the diagnostic basis of hypoxic states are also raised. Author

N64-28092 Joint Publications Research Service, Washington, D.C.
ELECTRIC PARAMETERS OF BIOLOGICAL TISSUE IN THE MICROWAVE RANGE
A. R. Livenson 28 Aug. 1964 11 p refs Transl. into ENGLISH from Med. Prom. SSSR (Moscow), v. 18, no. 6, 1964 p 14–20
(JPRS-26191; TT-64-41450) OTS: $1.00

Results of investigations indicate that all biological tissues can be broken down into two groups. The first group includes tissues with a high water content (skin, muscles, internal organs), and the second group is comprised of tissues with a low water content (fat, bone, bone marrow). The first group of tissues is characterized by a relatively high dielectric permittivity and low resistivity. The second group exhibits a dielectric permittivity lower by one order of magnitude and a resistivity higher by one order of magnitude. I.v.L.

N64-28111* Brandeis U., Waltham, Mass.
***BACILLUS SUBTILIS* DEOXYRIBONUCLEIC ACID TRANSFER IN PBS2 TRANSDUCTION**

I. Mahler, M. Cahoon, and J. Marmur Repr. from J. of Bacteriol., vol. 87, no. 6, Jun. 1964 p 1423–1428 refs
(Grant NsG-375)

Lysates of the general transducing bacteriophage PBS2 grown on *Bacillus subtilis* SB19 were fractionated by preparative CsCl density-gradient centrifugation. Five distinct and separate bands, which varied in their ability to transduce three nutritional markers, were obtained by this procedure. Deoxyribonucleic acid (DNA) samples prepared from unfractionated lysates and from each of the separate bands were examined by analytical CsCl density-gradient centrifugation. In addition to a major band (density, 1.723 g/cc) identified as PBS2 DNA, a satellite band of lighter density was detectable in the nucleic acids obtained from whole lysates and those bands that possessed transducing activity. The biological activity of the purified nucleic acids, determined by transformation experiments, was found to reside in the light satellite band (1.703 g/cc) characteristic of *B. subtilis* DNA. Author

N64-28114 Flying Personnel Research Committee (Gt. Brit.)
INDEX OF UNCLASSIFIED REPORTS AND MEMORANDA
London, Air Min., Jan. 1964 273 p refs
(FPRC/1178)

This document contains a list of 1,206 unclassified reports, 192 unclassified memoranda, and a personal author index. R.T.K.

N64-28141 General American Transportation Corp., Niles, Ill. MRD Div.
EXPERIMENTAL EVALUATION OF ENVIRONMENTAL CONTROL SYSTEMS FOR CLOSED SHELTERS
T. R. Charanian and J. D. Zeff Jul. 1964 59 p refs
(Contract OCD-PS-64-6)
(MRD-1242-2530)

This report summarizes the results of an experimental study of oxygen supply and carbon-dioxide control systems that are suitable for use in closed shelters for protection against fallout and/or other weapons effects. Thirty-six simulated occupancy tests and one human-occupancy test were conducted in order to evaluate the performance of passive carbon-dioxide absorption methods. Results are summarized as follows for a 24-hour closed period: (1) Oxygen supply can be provided at a cost of about $4.70 per person for smaller shelters (100-man) or about $4.15 per person in larger shelters (1,000-man). (2) A more extensive study is suggested in order to provide specifications, more accurate costs, and installation designs for various size and type shelters. (3) Carbon-dioxide concentration can be controlled by the use of Baralyme (or soda-lime at a slight loss in efficiency) in screened panels at a cost of about $4.50 per person. I.v.L.

N64-28228* Wilmot Castle Co., Rochester, N.Y. Research Labs.
STUDIES FOR STERILIZATION OF SPACE PROBE COMPONENTS Progress Report No. 3, 1 Mar.–1 Jun. 1964
Martin G. Koesterer [1964] 19 p
(Contract NASw-879)
(NASA-CR-58284) OTS: $1.60 ph

Research activities are reported in the following areas: studies on the dry-heat resistance of microorganisms recovered from air samples and added to sterile kaolin; and the demonstration of sterility or determination of the approximate level of contamination of commercial electronic components assayed for levels of contaminating organisms. R.T.K.

N64-28231* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GENETIC RECOMBINATION BETWEEN THE RESISTANCE TRANSFER FACTOR AND THE CHROMOSOME OF *ESCHERICHIA COLI*
Herbert S. Ginoza and Robert B. Painter Repr. from J. of Bacteriol., v. 87, no. 6, Jun. 1964 p 1339–1345 refs
(NASA-RP-296)

Genetic instability for high-level streptomycin and chloramphenicol resistance was observed in several strains of *Escherichia coli* infected with the resistance transfer factor (RTF) episome. The altered site was always found on the chromosome, and the resistance characteristics were similar to, if not identical with, the corresponding determinant found on the episome. The high-level drug-resistance phenotype was ascribed to two separate loci acting cooperatively within the host. The instability phenomenon was attributed to a genetic exchange mechanism in which the chromosome copies the drug-resistance information from the episome, thus giving rise to a diploid homogenote for this segment. In a reciprocal exchange system, the tetracycline-resistance marker on the chromosome was recombined with the RTF episome lacking this information. Author

N64-28288 Minneapolis-Honeywell Regulator Co., Minn. Military Products Group Research Lab.
THE EFFECTS OF HIGH-INTENSITY RADIANT STIMULATION OF VARYING WAVELENGTHS AND DURATIONS ON RETINAL SENSITIVITY Annual Progress Report, No. 1, 1 Jul. 1963–1 Jul. 1964
Norman A. Sidley [1964] 13 p refs
(Contract DA-49-193-MD-2457)
(Rept.-1549-TDR-1; AD-442513)

Apparatus was constructed for training monkeys to respond differentially to light stimuli, and electrophysiological procedures were developed for reliably determining their ERG response to repetitive light flashes. Computer techniques are able to record very low amplitude ERG's, such as may result following flash blindness. Histological-biochemical studies have identified enzymes which are sensitive to light falling on the retina. These studies will allow determination of changes in retinal chemical systems following flash blindness. Author

N64-28295* Brandeis U., Waltham, Mass.
THE COMPARATIVE ENZYMOLOGY OF LACTIC DEHYDROGENASES. II PROPERTIES OF THE CRYSTALLINE BEEF AND CHICKEN ENZYMES
Amadeo Pesce, Robert H. Mc Kay, Francis Stolzenbach, Robert D. Cahn, and Nathan O. Kaplan Repr. from J. Biol. Chem., v. 239, no. 6, Jun. 1964 p 1753–1761 refs
(Grants NsG-375; NSF G-20029; PHS-G-17680; NIH-CA-03611-06)
(Publ.-281)

Methods for isolating and crystallizing in pure form the chicken and beef skeletal muscle (M) lactic dehydrogenase as well as chicken and beef heart (H) enzymes are given. These pure enzymes consist of only one electrophoretic form. The molecular weights, within experimental error, of all four enzymes appear to be approximately the same. The sedimentation characteristics are also quite similar, although the possibility exists that the beef heart enzyme may be a molecule somewhat different in shape from the other three lactic dehydrogenases. Frictional ratios indicate that the lactic dehydrogenases are all elongated molecules. Author

N64-28309 Joint Publications Research Service, Washington, D.C.
PHOTOSYNTHESIS AND RADIATIVE TRANSITIONS
5 Aug. 1964 24 p refs Transl. into ENGLISH of 2 articles from Biofizika (Moscow), v. 9, no. 3, 1964 p 293–305
(JPRS-25733; TT-64-41004) OTS: $1.00

CONTENTS:
1. THE THERMODYNAMICS OF PHOTOSYNTHESIS L. H. Bell p 1–10 refs (See N64-28310 20-16)
2. DETERMINATION OF THE PROBABILITY OF SINGLET-SINGLET AND SINGLET-TRIPLET TRANSITIONS IN MOLECULES POSSESSING A CONJUGATE SYSTEM OF π-ELECTRONS Yu. V. Morozov and A. I. Kuklin p 11–21 refs (See N64-28311 20-16)

N64-28310 Joint Publications Research Service, Washington, D.C.
THE THERMODYNAMICS OF PHOTOSYNTHESIS
L. H. Bell *In its* Photosyn. and Radiative Transitions 5 Aug. 1964 p 1–10 refs (See N64-28309 20-16) OTS: $1.00

The thermodynamics of photosynthesis was investigated. Results indicate the following: (1) Thermodynamics imposes a restriction on the maximum possible energy yield from photosynthesis (η_m). (2) The highest theoretical values of η_m are obtained when plants are irradiated with light from bright sources. (3) The highest values of η_m are obtained when working with directed, monochromatic pencils of light, for a given irradiation of a plant. (4) The $\eta_m = 0.94$ in the case of plants irradiated with sunlight, if the rays are direct. In the case of "light-loving" plants, for which the compensation point is 500 erg/cm^2/sec, $\eta_m = 0.68$. (5) Thermodynamics does not permit the functioning of a four-quantum mechanism, at the lowest light intensities encountered in practice. I.v.L.

N64-28311 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF THE PROBABILITY OF SINGLET-SINGLET AND SINGLET-TRIPLET TRANSITIONS IN MOLECULES POSSESSING A CONJUGATE SYSTEM OF π-ELECTRONS
Yu. V. Morozov and A. I. Kuklin *In its* Photosyn. and Radiative Transitions 5 Aug. 1964 p 11–21 refs (See N64-28309 20-16) OTS: $1.00

This report deals with the values of the quantum yield and the average duration of fluorescence, at room temperature, for acridine orange in the following media: glycerin and glucose, phosphorus boroglyceride, and sugar crystals. I.v.L.

N64-28317* Documentation Incorporated, Bethesda, Md. Man-Machine Information Center
BIBLIOGRAPHY RELATED TO HUMAN FACTORS SYSTEM PROGRAM, JULY 1962–FEBRUARY 1964
Richard J. Potocko Washington, NASA, 1964 242 p refs
(NASA-SP-7014) OTS: $3.50

N64-28320* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RADIATION DOSIMETRY ABOARD THE SPACECRAFT OF THE EIGHTH MERCURY-ATLAS MISSION (MA-8)
Carlos S. Warren and William L. Gill Washington, NASA, Aug. 1964 22 p refs
(NASA-TN-D-1862) OTS: $0.50

The creation of an artifically trapped electron belt by a high-altitude nuclear explosion on July 9, 1962, made it necessary to place radiation dosimeters aboard the spacecraft used in the eighth Mercury-Atlas mission (MA-8) on October 3, 1962, since the last three orbits passed through a magnetic field anomaly where the belt exists at Mercury flight altitudes. Dosimeters on board the spacecraft of the MA-8 mission were a self-indicating ionization chamber, lithium fluoride thermoluminescent detectors, and nuclear emulsions. The measurements indicated that the astronaut received less than 30-millirads body-surface dose. Author

N64-28425 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM BULLETIN OF EXPERIMENTAL BIOLOGY AND MEDICINE, NO. 3, 1964
14 Jul. 1964 50 p refs Transl. into ENGLISH of 6 Articles from Byuleten' Eksperimental' no Biologii i Meditsiny (Moscow), v. 57, no. 3, 1964
(JPRS-25464; TT-64-31736) OTS: $1.25

Articles on the following topics are reported: (1) the effect of dark and light adaptation of the eye on the function of cutaneous thermoreceptors in man; (2) the effect of antibiotic therapy on serotonin and histamine levels in the blood and organs of irradiated rabbits; (3) the passage of Sr^{90} and Ca^{45} through the placenta of rats; (4) the effect of anti-irradiated-tumor-tissue serum on the mitotic activity of the Ehrlich carcinoma in mice; (5) cytospectrophotometric indications of the nonuniformity of premitotic DNA reduplication processes in the cells of mammals; and (6) the development of a method for separate graphic recording of ohmic and capacitance components of the elastric resistance of a section of human pulmonary tissue. M.P.G.

N64-28430 Joint Publications Research Service, Washington, D.C.
STUDIES IN HYGIENE AND SANITATION IN THE USSR
8 Sep. 1964 42 p refs Transl. into ENGLISH from Gigiyena i Sanit. (Moscow), v. 29, No. 4, 1964
(JPRS-26305; TT-64-41564) OTS: $2.00

CONTENTS:
1. LARGE SCALE CHEMISTRY AND PROBLEMS OF HYGIENE G. Kh. Shakhbazyan p 1–8
2. THE INFLUENCE OF INTENSE NOISE ON CERTAIN FUNCTIONS OF THE ORGANISM A. B. Strakhov p 9–20 refs
3. CERTAIN ASPECTS OF THE BIOLOGICAL ACTION OF ULTRASONICS IN CONNECTION WITH ITS APPLICATION IN INDUSTRY S. I. Gorshkov, O. N. Gorbunov, R. M. Nikol'skaya p 21–29 refs
4. A GERONTOLOGICAL MAP OF THE RUMANIAN PEOPLE'S REPUBLIC A. Chuka, R. Kresin et al p 30–39

N64-28431 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 104
25 Aug. 1964 53 p refs Transl. into ENGLISH from CHINESE Periodicals
(JPRS-26103; TT-64-41363) OTS: $3.00

CONTENTS:
1. A REVIEW OF RESEARCH AND DEVELOPMENT OF ACOUSTICS OF THE SEA You Fang-hu and Chiu Yung-te p 1–25 refs

2. STEADY INCREASE IN NUMBER OF COLLEGE GRADUATES FROM MINORITY PEOPLES IN SINKIANG p 26–27

3. YOUNG TEACHERS DISPATCHED TO LABORATORIES, PLANS PUT IN MOTION TO BUILD UP LAB WORK p 28–36

4. NORMAL FRANK VECTORCARDIOGRAM—COMPARED WITH THE CUBIC VECTOR SYSTEM Kung Lan-sheng, T'ao Ch'ing, Yang Ch'i-no, P'an Hua-shan, and Li Chao-chi p 37–38

5. ANALYSIS OF FRANK VECTORCARDIOGRAPHY IN ONE HUNDRED NORMAL INDIVIDUALS Huang Ming-hsin, Yu Kuo-jui, Hsia Yung-k'ang, and Hsu Hsueh-fang p 39

6. DURATION OF NORMAL HEART SOUNDS Kao Yun-ch'iu, Chin Jui-ho, Yang Ta-p'eng, Hsu Tsu-po, and Shih Shu-ku p 40

7. A CYTOCHEMICAL STUDY OF LEUKEMIC LEUCOCYTES—A DEMONSTRATION OF PEROXIDASE AND SUCCINIC DEHYDROGENASE Wang Sheng-yuan, Wu Chiang-sheng, and Fu Shih-hsien p 41–43

8. MORPHOLOGICAL DISTINCTION BETWEEN POLYMORPHONUCLEAR NEUTROPHIL LEUCOCYTES OF MALE AND FEMALE Lou Ch'i-chi, Yang Tsan-yuan, Ch'en Jen'chun, and Chung Ch'uan-ch'ing p 44–45

9. IDIOPATHIC HYPORARATHYROIDISM—A REPORT OF 11 CASES Yin Wei, Chang Chun, Wang Tun-mei, Kao Yu-ch'i, and Chu Hsien-i p 46

10. ATYPICAL SYMPTOMS OF BILIARY DISORDERS—AN ANALYSIS OF 70 CASES Wang Pao-szu, Chiang Po-ching, Kao Shou-cheng, Yu Chung-lin, and Ch'a Liang-i p 47–48

11. DIAGNOSIS OF LIVER PARASITES BY ULTRASOUND Chang Yen-po, Ni Shih-chen, Ch'en Wen-k'uei, Ch'i Chen-i, and Chang Chih-chan p 49–50

N64-28432 Joint Publications Research Service, Washington, D.C.

TRANSLATIONS FROM BOL'SHAYA MEDITSINSKAYA ENTSIKLOPEDIYA [MOSCOW] (GREAT MEDICAL ENCYCLOPEDIA), vol. 33, 1963

25 Aug. 1964 69 p refs Transl. into ENGLISH of 3 Articles from a RUSSIAN Periodical

(JPRS-26116; TT-64-41376) OTS: $3.00

CONTENTS:

1. UKRAINIAN SOVIET SOCIALIST REPUBLIC (The Ukraine) p 1–27 refs

2. ACCELERATION p 28–38 refs

3. CHEMOTHERAPY p 39–66 refs

N64-28439 Joint Publications Research Service, Washington, D.C.

ORGANIZATION OF MEDICAL COUNTERMEASURES AGAINST RADIATION ACCIDENTS DUE TO EQUIPMENT DAMAGE OR BREAKDOWN

K. Neumeister 20 Aug. 1964 14 p refs Transl. into ENGLISH from Deut. Gesundheitsw. (E. Berlin), No. 28, 9 Jul. 1964 p 1293–1297

(JPRS-26021; TT-64-41291) OTS: $1.00

The following medical needs and countermeasures against radiation accidents due to equipment damage or breakdown are discussed: (1) immediate first-aid measures in radiation accidents occurring in isotope laboratories; (2) radiation-accident-treatment measures in the clinic; (3) items needed by isotope laboratories for the initial care of radiation victims; (4) medication needed by the radiation-protection physician in caring for radiation-accident victims; (5) items required by the clinic for the care of radiation-accident victims; (6) government tasks in protection against nuclear weapons; (7) medical preventive measures for disaster control; and (8) the mission of medical clearing stations in cases of disaster. In addition, a classification of radiation injury is described. I.v.L.

N64-28446 Joint Publications Research Service, Washington, D.C.

STUDIES ON CONDITIONED REFLEXES

21 Aug. 1964 97 p refs Transl. into ENGLISH of 8 Articles from Zh. Vysshey Nervnoy Deyatel'nosti (Moscow), v. 14, no. 3, 1964

(JPRS-26060; TT-64-41330) OTS: $3.00

CONTENTS:

1. STUDY OF THE DYNAMICS OF THE FREQUENCY-SPECIFIC REACTION OF BRAIN AND RETINA BIOPOTENTIALS TO PROLONGED PHOTIC STIMULATION BY THE CORRELATION ANALYSIS METHOD N. N. Danilova p 1–15 refs

2. INFLUENCE OF THE SCHOOL DAY ON PERCEPTION OF TIME A. S. Dmitriyev, A. P. Ozhigova, and T. V. Tushmove p 16–28 refs

3. EXTINCTION OF THE ORIENTING REACTION AFTER CUTTING AND REMOVING THE AUDITORY CORTEX M. M. Karimova, D. M. Bowden, and Ye N. Sokolov p 29–39 refs

4. PHYSIOLOGICAL SIGNIFICANCE OF THE RHYTHM AND INTENSITY COMPONENTS OF THE ACOUSTIC FOOD CONDITIONED REFLEX V. I. Syrenskiy p 40–45 refs

5. RELATIONSHIP BETWEEN THE PRIMARY RESPONSE OF THE AUDITORY CORTEX IN WAKEFUL CATS AND THE TIME PARAMETERS OF THE SIGNAL G. V. Gershuni, I. A. Shevelev, and A. M. Likhnitskiy p 46–57 refs

6. INFLUENCE OF REMOVAL OF THE RABBIT CORTICAL VISUAL PROJECTION ZONE ON RESPONSES OF THE LATERAL GENICULATE BODY P. P. Gustson p 58–66 refs

7. FUNCTIONAL MORPHOLOGY OF INTERNEURON SYNAPSES N. N. Bogolepov p 67–82 refs

8. AUTOMATIC ANALYSIS OF THE DURATION OF THE ASCENDING AND DESCENDING PHASES OF ELECTROENCEPHALOGRAM OSCILLATIONS A. A. Genkin, V. K. Zakharov, and V. I. Tarabukin p 83–94 refs

N64-28448 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN PROBLEMS IN THE INFLUENCE OF IONIZING RADIATION ON THE NERVOUS SYSTEM

M. N. Livanov 4 May 1964 334 p refs Transl. into ENGLISH of the book "Nekotoryye Problemy Deystviya Ioniziruyushcheny Radiatsii na Nervnuyu Sistemy" Moscow, Gos. Izd. Med. Lit., 1962 p 5–196

(FTD-TT-63-582/1+2; AD-601827)

An analysis of a series of problems encountered in studying the effects of radiation on the nervous system is presented. The problems are divided into the following general categories: (1) sensitivity of the nervous system to exposure to ionizing radiation; (2) basic mechanisms of ionizing-radiation effect on the nervous system; (3) the intercentral relations in experimental radiation sickness; (4) hypothalamus as a factor in experimental acute radiation sickness; and (5) interdependence of some body functions and successive states affecting the cerebral cortex, induced by ionizing radiation. P.V.E.

N64-28562* Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio Naval School of Aviation Medicine, Pensacola
MOTION SICKNESS SYMPTOMATOLOGY OF LABYRINTHINE DEFECTIVE AND NORMAL SUBJECTS DURING ZERO GRAVITY MANEUVERS
Robert S. Kellogg, Robert S. Kennedy, and Ashton Graybiel Jun. 1964 15 p refs Prepared Jointly with Naval School of Aviation Med.
(NASA Order R-47)
(AMRL-TDR-64-47; AD-603339)

Labyrinthine defective (L-D) and normal subjects were flown through zero-gravity maneuvers and their motion sickness symptomatology observed. The L-D subjects showed no signs of motion sickness, whereas 64% of the normal subjects developed symptoms. The absence of functional labyrinthine mechanisms appreciably decreased, and probably completely eliminated, susceptibility to motion sickness during zero-gravity maneuvers. Author

N64-28565 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
X-20A FULL-PRESSURE SUIT QUANTITATIVE PERFORMANCE
J. D. Bowen May 1964 46 p
(AMRL-TDR-64-36; AD-603701)

A series of experimental procedures was accomplished to demonstrate and measure the protection X-20A Dyna-Soar pilots obtain by wearing their custom fitted pressure garments while exposed to simulated mission conditions. Mission conditions were simulated to the extent possible with available altitude and temperature test facilities. Physical characteristics of the garments were determined, such as weight, pressure drop with flow, dimensional stability, visual fields, and acoustical attenuation. Author

N64-28581 Innsbruck U. (Austria) Inst. of Experimental Psychology
COLOR DISCRIMINATION WITHOUT CHROMATIC VISION Second Annual Technical Report, Jul. 1, 1963–Jun. 30, 1964
Anton Hajos 1 Jul. 1964 94 p refs
(Contract DA-91-591-EUC-2917)
(Rept. 2; AD-603031)

The results of measurements obtained for experiments with prism glasses of three different types (cross-eye glasses, plugged glasses, and monocle glasses) are discussed. The measurements were taken for three distortion effects—displacement caused by deviation, curvature of straight lines caused by the differences of deviation depending on the angle-of-incidence of the beam passing through the prism, and the chromatic fringes formed by the dispersion of the prisms. The values show that aftereffects of displacement and curvature are totally transferred to the other eye. Two examples of values for displacement with a symmetrically opposite stimulus input are demonstrated with cross-eye glasses. The results of the measurements were different in each subject. Changes of values for rainbow fringes in all of the experiments conducted with cross-eye glasses clearly demonstrated that each eye adapts to rainbow fringes. The amount of adaptation lies in the same range as for other types of glasses. It is shown that the adaptation is of different magnitude for different subjects. R.T.K.

N64-28631 Joint Publications Research Service, Washington, D.C.
EFFECT OF T-1 BRAND FUEL UPON THE SKIN
L. V. Shevlyakov 6 Nov. 1962 4 p Transl. into ENGLISH from Voyenno-Med. Zh. (USSR), no. 5, 1955 p 83–84
(JPRS-16055) OTS: $1.10

A type of aircraft fuel was responsible for causing dermatitis, especially in mechanics. Treatment for this is described. G.D.B.

N64-28649* Texas U., Dallas Southwestern Medical School
A RELATIONSHIP BETWEEN GROWTH AND GRAVITY IN BACTERIA
P. O'B. Montgomery, F. Van Orden, and E. Rosenblum Repr. from Aerospace Med., v. 34, no. 4, Apr. 1963 p 352–354 refs
(Grant NsG-210-62)

When *E. coli* cultures are subjected to gravitational fields of 110,000 × g for 24 hours the following disturbances in growth were observed—increased log phase, prolonged generation time, decreased maximal concentration, and prolonged time required to reach maximal concentration. These alterations in growth patterns did not occur in bacterial cultures of *E. coli* subjected to a gravitational field of 1,000 × g for 24 hours. Author

N64-28659 Institut Pasteur, Paris (France)
INTERACTIONS OF THE RADIATIONS AND DESOXYRIBONUCLEIC ACIDS [INTERACTIONS DES RADIATIONS ET DES ACIDES DESOXYRIBONUCLEIQUES]
R. Latarjet Brussels, EURATOM, May 1964 12 p in FRENCH; ENGLISH summary
(Contract EURATOM-005-61-1 Biof)
(EUR-1646.f) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 22.186: 40 Belg. Fr.

The research results described in this document concern seven closely interrelated fields: (1) the radiochemistry of pyrimidine bases; (2) the action of radiation on transforming DNA of bacteria; (3) the radiobiology of lysogenic bacteria; (4) the effect of radioactive disintegrations in yeast; (5) the lethal effect of radioactive atoms incorporated in DNA; (6) the action of the radiations on genetic recombination; and (7) the radio peroxidation mechanism (application to DNA). Author

N64-28698 Flying Personnel Research Committee (Gt. Brit.)
PHYSIOLOGICAL REQUIREMENTS FOR PROTECTION AGAINST ATMOSPHERIC PRESSURE CHANGES
D. I. Fryer (RAF Inst. Aviation Med.) London, Air. Min., Nov. 1963 13 p refs Presented at the RAE Symp. on Pressure Suits, Apr. 1962
(FPRC/MEMO-201)

In the absence of any satisfactory method of obtaining protection by the provision of an adequately high ambient pressure, it may be necessary to resort to other means of influencing the susceptibility of exposed personnel. So far as is known, there is only one practical physiological method and that is to reduce the total amount of nitrogen stored in the body and, in particular, to reduce its concentration in certain particularly vital parts. In operational terms, this means maintaining preoxygenation with some pure oxygen at ground level, either in the crew room or in the aircraft for some considerable period before takeoff, with no breaches of oxygen discipline, or the use of air mix or pure oxygen at fairly high cabin altitudes. Fair estimates of hazards due to atmospheric pressure changes in terms of forced descents can be made in certain well-defined groups of personnel for periods up to 2 hours at high altitudes. Beyond 2 hours, extrapolation is required, and the accuracy of estimates is reduced. I.v.L.

N64-28764* Wilmot Castle Co., Rochester, N.Y. Research Labs.

STUDIES FOR STERILIZATION OF SPACE PROBE COMPONENTS Final Report, Aug. 1, 1962–Aug. 31, 1963

Martin G. Koesterer [1963] 44 p refs

(Contract NASw-550)

(NASA-CR-58285) OTS: $4.60 ph

Dry-heat sterilization of space probes, particularly at 125° and 135° C, was studied. Biological, chemical, and physical factors influencing the sterilization effectiveness of the dry-heat process were investigated. D.E.W.

N64-28767* Texas U., Dallas Southwestern Medical School

ULTRASTRUCTURAL ALTERATIONS INDUCED IN *E. COLI B* BY GRAVITY

P. O'B. Montgomery, Betty Neumeyer, and Eugene Rosenblum Repr. from Aerospace Med., v. 35, no. 4, Apr. 1964 p 360–361 refs

(Grant NsG-210-63)

Bacterial cells subjected to gravitational fields of 110,000 XG for 24 hours were examined by electron microscopy. Cells so treated appear larger than control cells. The enlargement appears to be due to an overall enlargement of the cell with hypertrophy of some of the intracellular components. The possibilities that these observations are due to a dissociation between cell growth and cell division, and that they may represent genetic changes are considered. Author

N64-28788 Oak Ridge National Lab., Tenn.

EFFECTS OF RADIATION ON THE MAMMALIAN EYE. A Literature Survey

H. D. Lazarus Jul. 1964 30 p

(TID-3912) Available from Natl. Bur. of Standards, Springfield, Va.

A subject index is presented for a companion document, "Effects of Radiation on the Mammalian Eye, A Literature Survey." References in this subject index are referred to page numbers in the literature survey. M.P.G.

N64-28812 Pennsylvania U., Philadelphia

NON-THERMAL EFFECTS OF ALTERNATING ELECTRICAL FIELDS ON BIOLOGICAL STRUCTURES Final Report, 1 Jan. 1963–29 Feb. 1964

Herman P. Schwan 30 Apr. 1964 13 p refs

(Contract Nonr-551(05))

(AD-600263)

Four nonthermal effects of alternating electrical fields have been assessed for their possible biological significance. The effects, all the result of mechanical forces on particles dispersed in a fluid, are these: (1) pearl-chain formations that do not occur in human beings exposed to a microwave beam with an incident rms power density of less than 10 mw/cm^2; (2) orientation of nonspherical particles that is most unlikely in human beings, since it is improbable that any histological structure is superficial, sufficiently large, and free to be oriented; (3) forces in inhomogeneous fields due to microwave irradiation appear to be of no biological significance, since skin has no freely movable, micron-size particles; and (4) the effect of alternating electrophoresis at microwave frequencies has been demonstrated to be infinitesimal. None of the four nonthermal effects, therefore, has biological significance for human beings exposed to a "thermally safe" microwave field. A.W.

N64-28833* Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center

SPINAL MOTOR RESPONSES TO ACOUSTIC STIMULATION Report No. 2

Bo E. Gernandt and Harlow W. Ades 22 Apr. 1964 18 p refs

(NASA Order R-93)

(NASA-CR-58548) OTS: $1.60 ph

Certain aspects of the mechanisms mediating auditory-induced spinal motor activity were examined by recording within the bulb and from motoneurons at both cervicothoracic and lumbosacral levels. Single auditory click stimulation elicits, in lightly strychninized cats, motor responses appearing along both sides of the spinal cord. In competition for access to the final common path, the evoked descending acoustic volley of impulses is readily blocked by prior dorsal root stimulation. Since the ventral root responses recorded contralaterally to the side of auditory stimulation have the same appearance, respond identically to higher frequency stimulation, and interact with dorsal root responses in an identical manner, as do the ipsilateral ventral root responses, it is assumed that the acousticospinal mechanisms on the two sides of the spinal cord are mirror images of each other, elicited from a common brain stem neuronal pool. Decerebration and cerebellectomy do not interfere with the transmission of this acousticospinal reflex activity. Auditory projections to the brain stem reticular formation are evidently sufficient to maintain the pattern of the descending reflexes. Bilateral motoneuron discharges following unilateral acoustic stimulation are insured by an abundance of functional crossings in the bulb and along the extent of the spinal cord. I.v.L.

N64-28838* Northrop Corp., Hawthorne, Calif. Northrop Space Labs.

INVESTIGATION OF *PEROGNATHUS* AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY Second Quarterly Progress Report, 1 Apr.–31 Jul. 1964

J. J. Gambino and R. G. Lindberg [1964] 25 p refs

(Contract NASw-812)

(NASA-CR-58526; NSL-64-29-3) OTS: $2.60 ph

High $LD_{50/30}$ values exhibited by two species of pocket mice, *Perognathus longimembris* and *P. formosus*, suggest a natural resistance to whole-body irradiation in this genus unparalleled among the mammals. In order to test the hypothesis that low oxygen tension may be acting to produce the observed low radiation sensitivity, an experiment was designed to determine whether hypoxia of critical radiosensitive tissues is present in pocket mice during irradiation. It was found that pocket mice, like most hibernators, adjust to a reduction in ambient oxygen by reducing their body temperature; however, arousal occurs immediately after normal atmospheric oxygen is restored. More animals were found to tolerate a gradual oxygen reduction to levels that were lethal for sudden exposure, suggesting that pocket mice may not be tolerant to hypoxia at the cellular level but rather that their hypoxia tolerance may be based solely on their efficiency in reducing metabolic need for oxygen. The fact that *Perognathus* can survive 5% oxygen at 10° C ambient temperature suggests a means for reducing even further payload requirements in space biology experiments. M.P.G.

N64-28859 Joint Publications Research Service, Washington, D.C.

SPACE BIOLOGY AND MEDICINE

V. I. Yazdovskiy 2 Sep. 1964 74 p Transl. into ENGLISH of the book "Biologiya i Kosmos; Problemy Kosmicheskoy Biologii i Meditsiny" Moscow, Znaniye Publishing House, 1964 p 3-80
(JPRS-26231; TT-64-41490) OTS: $3.00

Reasons for the exploration of space are discussed, along with the problems that will be encountered. Problems discussed include zero gravity, large acceleration forces, absence of suitable atmospheres, and time lapses in traveling to distant reaches of space. P.V.E.

N64-28876* Naval School of Aviation, Pensacola, Fla. Naval Aviation Medical Center
THE EFFECTS OF CORIOLIS ACCELERATION DURING ZERO GRAVITY FLIGHT ON CERTAIN HEMATOLOGICAL AND URINARY PARAMETERS IN NORMAL AND LABYRINTHINE DEFECTIVE SUBJECTS Report No. 2
James K. Colehour 19 May 1964 13 p refs
(NASA Order R-93)
(NASA-CR-58675) OTS: $1.60 ph

When normal subjects were exposed to repetitive, zero gravity, parabolic flight, significant increases in neutrophils, eosinophils, and urinary 17-hydroxycorticosteroids occurred as indicators of stress. In similar experiments when Coriolis acceleration was additionally imposed during zero gravity, much greater stress was indicated by the same measurements. Subjects with meningitis-derived labyrinthine defects did not respond in a similar manner. It is concluded that functionally intact vestibular organs must be present to activate the hypothalmic-pituitary-adrenal axis in abnormal g environment. Author

N64-28894* California U., Berkeley Space Sciences Lab.
CHEMISTRY OF LIVING SYSTEMS Annual Progress Report, Period Ending Jul. 1, 1964
Thomas H. Jukes 1 Jul. 1964 26 p
(Grant NsG-479)
(NASA-CR-58547) OTS: $2.60 ph

Progress and results are reported for studies on enzyme content and function of polysomes, sequence of bases in RNA, RNA polymerase, composition and function of the chromosome of *Bacillus subtilis*, and the mechanism of antibody production. D.E.W.

N64-28916 Montana State Coll., Bozeman Electronics Research Lab.
TOWARDS A THEORY OF THE RETICULAR FORMATION Scientific Report No. 1
W. L. Kilmer and W. S. Mc Culloch Apr. 1964 43 p refs
(Contract AF 19(628)-3807)
(ERL-8-0009-622; AFCRL-64-463; AD-604883)

Throughout the life of the vertebrates, the core of the central nervous system, sometimes called the reticular formation, retained the power to commit the whole animal to one mode of behavior rather than to another. Its anatomy, or wiring diagram, is fairly well known, but to date no theory of its circuit action has been proposed that could possibly account for its known performance. Its basic structure is that of a string of similar modules, wide but shallow in computation everywhere, and connected not merely from module to adjacent module, but by long jumpers between distant modules. Analysis of its circuit actions heretofore proposed in terms of finite automata or coupled nonlinear oscillators has failed. Proposed are probabilistic automata that handle regular events as proper modules, and give some novel stability theorems regarding them. The behavior of a connected chain of such modules is still under investigation. Author

N64-28935* Stanford Research Inst., Menlo Park, Calif.
STUDIES ON THE HILL REACTION ACTIVITY OF SOLUBLE CHLOROPLAST EXTRACTS Quarterly Progress Report, 1 Mar.-1 Jun. 1964
Bruce Graham 21 Aug. 1964 10 p refs
(Contract NASr-49(11))
(Rept.-5; NASA-CR-58340) OTS: $1.10 ph

This study is concerned with the mechanisms and essential reactants of that part of the photosynthetic process in which oxygen is produced by photolysis of water. This is essentially the light absorbing reaction that can be studied in vitro separately from the carbon dioxide fixing reactions. The photolysis of water and evolution of oxygen that occur when chloroplasts or fragments of them are illuminated in the presence of a suitable electron acceptor are generally referred to as the Hill[17-18] reaction. Attempts to reduce the Hill reaction system to a nonparticulate state have generally resulted in loss of activity. Author

N64-28939* United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
[APPLICATION OF STATISTICAL DECISION TECHNIQUES TO THE CHOICE OF EXTRATERRESTRIAL LIFE DETECTORS] First Quarterly Progress Report
Dian R. Hichcock and Gordon B. Thomas [1964] 11 p
(Contract NASw-871)
(NASA-CR-58531) OTS: $1.60 ph

The activities were directed primarily at surveying some of the decision problems associated with the extraterrestrial life-detection program, orienting project personnel, identifying concrete subproblems to be employed as vehicles for the development of operational analysis and statistical decision techniques, and initial efforts directed toward exploring and solving these problems. A brief description of the first model to be simulated is included. Author

N64-28947* Armed Forces Inst. of Pathology, Washington, D.C.
INFLUENCE OF HYDRAZINE AND HYDRAZINE DERIVATES ON INTERMEDIARY METABOLISM
Abel M. Dominguez, Joseph S. Amenta, and Thaddeus J. Domanski [1964] 2 p Preprint of a Paper Presented at the Aerospace Med. Assn. 35th Ann. Sci. Meeting, Bal Harbour, Fla., 11-14 May 1964
(Contract NASA A-31086)

The possibility of application in vivo of a rapid screening technique for metabolic studies of chemical toxicity of hydrazine and its derivatives 1,1 dimethylhydrazine (UDMH), 1,2 dimethylhydrazine (SDMH), monomethylhydrazine (MMH), and iproniazid was studied in rats. The experiments were based on the measured rate of expiration of $C^{14}O_2$ derived from injected, labeled amino acids and acetate. The findings were evaluated by analysis of variance. A dose of nonlabeled substrate (1 or 3×10^{-3} moles) injected intravenously showed a 70% to 80% reduction in the ability of hydrazine-treated animals to oxidize glycine-1-C^{14}. No difference was noted with acetate-1-C^{14}. Similar results were received with MMH, UDMH, and, to a lesser degree, with SDMH and iproniazid. The conversion of glucose C^{14} (UL) was depressed in hydrazine- and UDMH-treated animals. Author

N64-28949* General Dynamics Corp., Groton, Conn. Electric Boat Div.
MULTIFILTER SYSTEM FOR WATER RECLAMATION
H. Wallman, J. Steele, and J. Lubitz [1964] 5 p refs Preprint of a paper presented at the Aerospace Med. Assn. 35th Ann. Sci. Meeting, Bal Harbour, Fla., 11-14 May 1964
(Contract NASI-2208)

The multifilter subsystems were tested and found to give recovered water of the required quality. The dehumidification water subsystem produced potable water from air-conditioning condensate obtained from a space simulator. The wash water subsystem produced water suitable for reuse as wash water. The multifilter scheme is recommended on the basis of its high reliability, simplicity, zero power requirement, and inherent zero-g capability. Based on the amount of water remaining in the subsystems, the following water recovery efficiencies were calculated: dehumidification water system — 99.5%; wash water subsystem — 99.0%. Author

N64-28950* School of Aerospace Medicine, Brooks AFB, Tex.
HEART RATE PATTERNS OBSERVED IN MEDICAL MONITORING
David G. Simons and Robert L. Johnson [1964] 5 p refs Preprint of a Paper Presented at the Aerospace Med. Assn. 35th Ann. Sci. Meeting, Bal Harbour, Fla., 11–14 May 1964
(Sponsored by NASA)

A classification and examples of heart rate patterns observed in response to a variety of stresses encountered in space flight are presented. The pattern classification provides a basis for automated quantification of heart rate responses. Conditions under which these patterns have been observed include sleep, quiet resting while awake, clinical dynamic stress testing, (breath-holding and hypoxia), and aircraft flight exposure to increased g-forces. The electrocardiograph and the cardiotachometer were used for observations. Author

N64-29018 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT MICROORGANISMS IN PERMAFROST
A. Ye. Kriss 10 Feb. 1964 16 p refs Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 9, no. 9–10 1940 p 879–887
(FTD-TT-63-929/1+2; AD-436794)

A detailed account is presented of the collecting of samples of permafrosts of various ages and compositions and of the subsequent microbiological assays of each. The samples were collected from the frozen state and active layer on Kolyuchin Island and Vrangel Island in the eastern regions of the Arctic. Kolyuchin Island frozen-ground microflora consisted of a nonsporiferous bacillus, sporiferous bacteria, and actinomycetes; the active layer contained fungi as well. Vrangel Island frozen ground did not yield any microorganisms except from a frozen peat layer; the active layer consisted of nonsporiferous and sporiferous bacteria, actinomycetes, and fungi. Planned investigations on a larger scale are necessary before any conclusions can be drawn about the survival limits of microorganisms under the effect of constant negative temperatures. M.P.G.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-27874* North American Aviation, Inc., Los Angeles, Calif.
DETERMINATION OF TIG WELDING CONTROL PARAMETERS AND REQUIREMENTS FOR THE AUTOMATION OF OUT-OF-POSITION WELDING, PHASE II
J. M. Lambase 27 Nov. 1962 42 p refs
(Contract NAS8-2601)
(NASA-CR-56654; NA-62-864-1) OTS: $4.60

An oscillator was designed and built that has an adjustment mechanism for varying bead width during the welding operation. This oscillator produced satisfactory weld joints. A comparison investigation conducted between the cross seam, radius, and adjustable oscillators indicated no appreciable differences in weld quality, bead appearance, and heat-affected zones for joints made with the three oscillators. Automatic welding was performed in the vertical (travel up and down) and the overhead positions. Excellent sidewall and interpass fusion was obtained in 2014 and 5456 aluminum plate alloys welded in these positions. Author

N64-27880* Worthington Corp., Harrison, N.J. Advanced Products Div.
THE WORTHINGTON INDUCER
W. K. Jekat 20 Feb. 1964 291 p
(Contract NAS8-2680)
(NASA-CR-56315) OTS: $18.50 ph

The Worthington inducer differs from the conventional pump inducer by having a shroud and no hub. Drastic vane sweepback can be employed. There is no vane clearance cavitation because there is no such clearance. Also, vane inlet cavitation was eliminated by sweepback. When cavitation starts to occur, it is at the end of the inducer. Cavitation bubbles are partly centrifuged into the fluid core where they collapse harmlessly. Maximum suction specific speed reached was 55,000 with 153° F water. Suction specific speed increases with rotative speed and temperature. A large body of test data and cavitation photographs is presented. Analysis includes scaling, velocity schedules, speed effect, temperature effect, boundary-layer buildup, friction, incidence, and residence time. A special form of Reynolds number correlates both speed and temperature effect. Pounding (low frequency vibrations at low capacities) was eliminated by mating the original inducer with a redesigned impeller. Dropping the liquid level to the center of the inlet does not interrupt pumping. This novel inducer appears promising, since it eliminates many disadvantages of the conventional screw-type inducer. Author

N64-27900* Midwest Research Inst., Kansas City Mo.
RESEARCH ON BEARING LUBRICANTS FOR USE IN HIGH VACUUM Annual Summary Report, 23 Mar. 1962.–22 Apr. 1963
Vern Hopkins and D. H. Gaddis 30 Aug. 1963 47 p refs
(Contract NAS8-1540; MRI Proj. no. 2492-E)
(NASA-CR-58204) OTS: $4.60 ph

Binder development studies were performed to develop better binders for solid lubricant films during the past year. Potassium silicate was selected as a basic binder. Preliminary results show that the wearlife of this binder material may be increased by additives such as sodium phosphate, potassium phosphate, sodium borate, or sodium fluoride. A search for additional lubricants or lubricant film components was conducted. Nine potential materials were selected for formulation and evaluation. A gear apparatus and pellet apparatus were designed, built, and used to investigate solid lubricant film wear life in air at room temperature. Wear characteristics of MLF-5(MoS_2 + graphate + gold–sodium silicate) obtained

in the early runs with the pellet apparatus are presented graphically. MLF-5 and other solid lubricant films were applied to a number of parts and components. A number of modifications that were made on the vacuum friction apparatus to improve its overall operating efficiency are described. Author

N64-27904* Space-General Corp., El Monte, Calif.
REPORT ON AN INVESTIGATION OF PROBLEMS IN THE MEASUREMENT OF THIN EVAPORATED METAL FILMS ON MYLAR
Earl G. Blackwell Jun. 1964 46 p
(Contract NAS1-1732)
(NASA-CR-58209; SGC-220S-3) OTS: $4.60 ph

From the plots of thickness vs sheet resistivity and thickness vs mass–unit area, a predictable correlation is shown with the copper and gold samples. It is also seen that these functions are displaced from wrought characteristics. Aluminum showed a great deal of scatter from any predictable relationship. Individual thickness determinations measured directly under the microscope are subject to considerable scatter from the average thickness as they are confined to a single point. Therefore, several cross sections should be averaged if direct linear thicknesses are made. Indirect thickness determinations showed less scatter, as their measurements involved a finite area. It is indicated from this study that nondestructive instruments whose measurement principle is based on resistivity or comparative mass per unit area may be used for thickness indications of copper or gold evaporated films on mylar, provided these instruments are calibrated by samples of known thickness and identical deposition processes. Author

N64-27918 General Electric Co., Cincinnati, Ohio Missile and Space Div.
DYNAMIC SHAFT SEALS IN SPACE Quarterly Report, Period Ending Apr. 15, 1964
[1964] 23 p
(Contract AF 33(657)-8469)
(QR-8; AD-601338)

Discussed, in terms of the current status, are the liquid-metal seal test rig, the liquid-metal seal facility, and data reduction. G.D.B.

N64-27945* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FRICTION, WEAR, AND DYNAMIC SEAL STUDIES IN LIQUID FLUORINE AND LIQUID OXYGEN
W. F. Hady, G. P. Allen, H. E. Sliney, and R. L. Johnson Washington, NASA, Aug. 1964 17 p refs
(NASA-TN-D-2453) OTS: $0.50

Friction and wear studies were conducted with four material combinations run submerged in liquid oxygen and in liquid fluorine to determine their potential as dynamic seal components for fluorine turbopump applications. The friction and wear experiments were conducted with a 3/16-in.-radius hemispherically tipped rider sliding in a circumferential path on the flat surface of a rotating 2-1/2-in.-diam disk. The seals used in this investigation had a flame-sprayed Al_2O_3 nosepiece (0.006- to 0.008-in. thick) and were run against a mating disk of TiC cermet or a fused coating of CaF_2 + LiF + NiF_2 on Al_2O_3 submerged in liquid fluorine. Results indicated that the presence of a fluoride film, either as an applied fused coating (CaF_2 + LiF + NiF_2) or as a film formed during sliding (NiF_2 on the TiC cermet or possibly aluminum fluoride (AlF_3) on Al_2O_3) in liquid fluorine, was beneficial in reducing the friction and wear of the Al_2O_3 riders. The seal experiments in liquid fluorine showed that flame-sprayed Al_2O_3 sliding against the TiC cermet or a fused coating of CaF_2 + LiF + NiF_2 on Al_2O_3 are potential seal materials for fluorine turbopump applications. Author

N64-27950 Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR MECHANIZATION OF HIGH-RELIABILITY CAPACITORS Third Quarterly Report, Jun. 30–Sep. 30, 1963
E. J. Burke and J. H. D. Folster [1963] 17 p
(Contract DA-36-039-AMC-01460(E))
(QR-3; AD-601429)

Work on production design engineering and design of pilot line equipment continues. The various parts of the component assembly machine are either now being designed or tested. The methods for accomplishing the magazine input and magazine output operations for the cover soldering machine were established. It was determined feasible to combine the actions of the hot and cold tubulation soldering machines. Author

N64-27960 Assembly Products, Inc., Chesterland, Ohio
PRODUCTION ENGINEERING MEASURE FOR METERS, TAUT-BAND SUSPENSION, A-C MOVING IRON VANE PER SIGNAL CORPS REQUIREMENTS SCS-160 Quarterly Progress Report, Feb. 1–Apr. 30, 1964
R. H. Nichols 29 May 1964 12 p refs
(Contract DA-36-039-AMC-01473(E))
(QPR-4; AD-601491)

Tests were performed on state-of-the-art samples to determine whether any of the environmental tests would present major problems in passing qualification tests. Included in this series were tests to determine the effects of temperature, frequency, external magnetic field, vibration, and high impact shock. Considerable difficulty was encountered in shock testing. An extensive study of the shock machine showed that it produces more severe conditions than required. Several components were improved to facilitate easier manufacture. Author

N64-28053 General Dynamics/Astronautics, San Diego, Calif.
ULTRAVIOLET STABILITY TESTS FOR TWO WHITE PAINTS
William Clausen, Karl H. Meyer, and Joseph L. Percy Feb. 1964 43 p refs
(GDA-ERR-AN-64-487)

Two white paints were exposed to ultraviolet radiation doses equivalent to approximately 1,000 hr of extraterrestrial sunlight. The two paints had titanium dioxide pigment with epoxy base, and antimony trioxide pigment with potassium silicate base. The accelerated tests were run with integrated intensities for wavelengths below 4,000 A of 42.46 times the solar intensities in the same region. Solar absorptance and emittance data are presented as a function of exposure time in tabular and graphical form. Author

N64-28115 Fraunhofer-Gesellschaft zur Forderung der Angewandten E. V., Darmstadt (W. Germany)
THE STRENGTH VALUE OF SINGLE-SHEARED LIGHT METAL RIVETED JOINTS [ZEITFESTIGKEIT EINSCHNITTIGER LEICHTMETALL-NIETVERBINDUNGEN]
W. Schutz [1962] 100 p refs in GERMAN; ENGLISH summary
(F-47; ICAF-268)

Tests were carried out to determine the fatigue behavior of six types of rivet joints in the range of 10^4 to 10^5 cycles

at a testing frequency of 30 cycles per minute. The test program was based on a minimum of 10 tests per stress level and per series in order to facilitate statistical evaluation of the results. The results of the test series are discussed in detail, and recommendations are made for fatigue design rules for riveted joints. R.T.K.

N64-28117 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
EQUIPMENT FOR CYCLIC HEATING OF STRESS RUPTURE SPECIMENS
H. P. van Leeuwen Nov. 1962 30 p refs
(NLR-TM-M.2102; ICAF-255)

Equipment was developed for static loading and cyclic heating of sheet specimens. A conventional creep frame, a high-frequency generator, thermocouples, and a temperature recorder are applied. The equipment and its operation are described. Author

N64-28122 Electrical Testing Labs., Inc., New York, N.Y.
EXAMINATION AND TEST OF FOUR SAMPLES OF CONTROL CABLE Interim Report
E. H. Salter 9 Jul. 1964 13 p
(Contract FA-WA-5080)
(Rept.-391111)

This report covers the unsuccessful tests and examinations of cable samples, made in an effort to determine the cause of nonconformance of one of these cables with paragraphs 3.4.2 and 4.2.6 of Specification FAA-E-2004. I.v.L.

N64-28130 Olin Mathieson Chemical Corp., New Haven, Conn. Organics Div.
DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUIDS AND LUBRICANTS Bimonthly Progress Report, Apr. 18–Jun. 17, 1964
H. F. Lederle and E. H. Kober 24 Jun. 1964 38 p
(Contract NObs-90092)
(BMPR-4; AD-601677)

A number of mixed substituted trimeric and tetrameric (arylamino-polyfluoroalkoxy) phosphonitriles were prepared. A typical representative of this new class of compounds, bis-(N-methylanilino)-hexakis (1,1-di H-trifluoroethoxy) phosphonitrile, passed the hydrolytic stability test of specification MIL-H-19457A and gave also excellent results in the Falex wear test. Another representative, bis(N-methylanilino)-tetrakis (1,1-di H-trifluoroethoxy) phosphonitrile, gave viscosities approaching those of the same specification. Catalytic reduction of trimeric bis(p-nitrophenyl) phosphonitrilate afforded bis(p-aminophenyl) phosphonitrilate in excellent yield. Ethoxylation of the latter resulted in the consumption of 10.8 moles of ethylene oxide per amino-group to give a water soluble material having potential for use in water base hydraulic fluids. Representatives of the novel class of arylthio-polyfluoroalkoxy phosphonitriles were synthesized but displayed slow hydrolytic instability and poor lubricity. Author

N64-28139 Bureau of Mines, Albany, Ore.
EXPENDABLE CASTING MOLDS FOR REACTIVE METALS
S. L. Ausmus and R. A. Beall Nov. 1963 50 p refs
(Contract AT(11-1)-599))
(BM-RI-6509)

The development of a completely water-free expendable graphite mold material, useful for reactive metal castings, was detailed. Mixing and curing variables were evaluated both by physical testing of the material itself and by castings of titanium, zirconium, and hafnium. The blend of powdered graphite, cornstarch, dextrin, cereal binder, linseed oil, and Carbowax-4000 is a successful mix when mulled in a carbon dioxide atmosphere, and properly cured and fired. The primary advantage of this material is its adaptability to standard foundary techniques; i. e., core blowing and hand ramming. Temperatures in the curing and firing cycles do not exceed 960° C, and no vacuum firing is required. Author

N64-28151 Collins Radio Co., Newport Beach, Calif.
FILTER CRYSTAL DEVELOPMENT PROGRAM (70 TO 150 MC) Second Quarterly Progress Report, 15 Oct. 1963–15 Jan. 1964
R. A. Auriemma and W. D. Peterson 25 Mar. 1964 13 p refs
(Contract D36-039-AMC-03207(E))
(Rept. 2; AD-437925)

A study of filament vapor source–target configurations was initiated. A special lapping–polishing machine for quartz blanks was designed and built. Author

N64-28159 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. SUPPLEMENT TO VOLUME VII—HIGH DENSITY RECRYSTALLIZED GRAPHITE BY HOT FORMING Technical Report, Sep. 1961–May 1962
G. L. Rowe and M. B. Carter Jul. 1963 36 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72; AD-278603)

This report describes the development and fabrication techniques utilized in the scale-up of grades ZTE and ZTF graphite to 30-in.-diam sizes. Grades ZTE and ZTF graphite that are normally characterized by a bulk density range of 1.92 to 1.97 g/cc and 1.97 to 2.02 g/cc, respectively, are manufactured by hot working grade RVA graphite that is characterized by a bulk density of 1.84 g/cc under pressures as high as 3,500 lbs./in.^{2} and temperatures up to 3,000° C. The physical properties of a 30-in.-diam ZTE graphite billet are tabulated along with the properties of RVA graphite. Author

N64-28210* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FEASIBILITY OF LIQUID-METAL VACUUM SEALS
J. E. A. John, D. A. Akins, and G. S. Pick *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 7 p refs (See N64-28201 20-23) OTS: $19.75 ph

A procedure was found for using a liquid-metal seal in an ultrahigh-vacuum system. Leak rates through a 5.5-in.-diam seal were so small that, with a chamber pressure of 1μ, there was no indication on a leak detector with a sensitivity of 3×10^{-10} standard cc of helium per second. Also, leakage was small enough to give no appreciable in-bleed to a system at a chamber pressure of 7×10^{-9} torr. The liquid-metal seal, essentially eliminating gas permeation and requiring a very small force per unit length to achieve a seal, has several advantages over the conventional O-ring and metallic shear seals. However, because of the extensive preliminary procedure required to prepare the flanges and liquid metal for the seal, the liquid-metal seal would be difficult to use on a routine basis. Author

N64-28226 Battelle Memorial Inst., Columbus, Ohio
DESIGN CRITERIA FOR HIGH-SPEED POWER-TRANSMISSION SHAFTS Third Quarterly Report, Phase II, Aug. 15–Nov. 15, 1963
H. C. Meacham and John E. Voorhees Wright-Patterson AFB, Ohio, ASD, Nov. 1963 37 p refs
(Contract AF 33(657)-10330)
(ASD-TDR-62-728; AD-423719)

Supercritical shaft operation was studied using a 3/8-in.-diam 124-in.-long aluminum shaft subjected to torque, curvature, and axial force. Damping coefficients for both the full-scale shaft of the Vertol Chinook helicopter and a dynamic model shaft were derived, and a design for the Chinook damper was developed. Digital computer work established the effects of moment restraint on shaft critical speed. The laboratory setup necessary to measure the damping coefficient of the experimental shaft dampers was completed, as was the setup that will be used to study the effects of external vibration on shaft operation. Author

N64-28240 National Semiconductor Corp., Danbury, Conn.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND INCREASE THE RELIABILITY OF THE 2N328A TRANSISTOR Quarterly Progress Report, 31 Dec. 1963–31 Mar. 1964
R. R. Rau [1964] 41 p
(Contract DA-36-039-AMC-01480(E))
(QPR-3; AD-444162)

The current status includes these efforts: (1) An etch wheel has been installed, resulting in significant improvement in yield as well as in performance during step-stress testing. (2) Furnaces for longer bake-out times for transistors were installed and evaluated. (3) The automatic standby system was installed and is operational. (4) The "C" bend shield was installed on the manufacturing line. (5) Aluminum units were fabricated that demonstrated a high yield to BV_{CEO} sort indicating a very good control on the base width. (6) Results of step-stress testing indicate that the present alloy transistor has improved its reliability and is approaching the contract goal. In addition, the results have allowed the long-term life tests to be rescheduled for shorter times and higher powers than originally planned; more information on the reliability of the unit will result from these tests. I.v.L.

N64-28241 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 103
13 Aug. 1964 42 p refs Transl. into ENGLISH of 4 articles from Chinese Periodicals
(JPRS-25901; TT-64-41172)

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N64-28242 Joint Publications Research Service, Washington, D.C.
A SHORT REVIEW OF THE GENERAL ASPECTS OF METALLURGICAL HEAT TREATMENT AND PROSPECTS FOR THE FUTURE
Chou Chih-Hung *In its* Transl. on Communist China's Sci. and Technol., No. 103 13 Aug. 1964 p 1–15 Transl. into ENGLISH from Shang-Hai Chi-Chieh (Shanghai), No. 3, Mar. 1964 p 1–6 (See N64-28241 20-17) OTS: $2.00

The development in recent years of heat-treatment techniques is discussed. The trend in production methods is toward more mechanization, the use of a combination of cold- and hot-treatment techniques, the use of metallurgy and heat-treatment theory to modify and improve processes, and the development of new methodology. R.T.K.

N64-28243 Joint Publications Research Service, Washington, D.C.
PROBLEMS RELATED TO THE DEVELOPMENT AND IMPROVEMENT OF HEAT TREATMENT FURNACES
Ch'iu Chi *In its* Transl. on Communist China's Sci. and Technol., No. 103 13 Aug. 1964 p 16–26 Transl. into ENGLISH from Shang-Hai Chi-Chieh (Shanghai), no. 3, Mar. 1964 p 7–10

The following are discussed: heat-treatment techniques; heat sources and the use of fuel; the materials for building furnaces; and the design of electric-resistance, salt-bath, and coal heat-treatment furnaces. R.T.K.

N64-28276 Southwest Research Inst., San Antonio, Texas
LUBRICATION RESEARCH AND TEST METHOD DEVELOPMENT FOR AEROSPACE PROPULSION SYSTEMS Technical Documentary Report, Mar. 15, 1963–Feb. 14, 1964
B. B. Baber, W. R. Blackstone, R. A. Burton, P. M. Ku, and J. A. Russell Wright-Patterson AFB, Ohio, AF Aeropropulsion Lab., May 1964 145 p refs
(Contract AF 33(657)-11088)
(APL-TDR-64-50; AD-600924)

The work performed under this program was concerned with applied research in the broad field of lubrication related to advanced primary and secondary aerospace propulsion systems. Two principal phases were investigated: impact sensitivity of materials in contact with rocket propellants, and lubrication, friction, and wear mechanisms in the cryogenic temperature range. Author

N64-28292 Institute of Electrical and Electronics Engineers, New York, N.Y.
FOURTH ANNUAL SEMINAR ON RELIABILITY IN SPACE VEHICLES
[1963] 156 p refs Seminar held in Los Angeles, 6 Dec. 1963 Available from Western Periodicals Co., 13000 Raymer St., N. Hollywood, Calif.: $6.50

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6. COMPONENT EVALUATION AND SELECTION FOR SPACE ENVIRONMENT L. W. Geary (Hughes Aircraft Co.) 18 p

7. COMPONENT FAILURE EFFECT ON SYSTEMS, AN ANALYTIC MODEL J. Pauperas, Jr., and R. L. Parkhill (Douglas Aircraft Co.) 50 p

N64-28293 Lockheed Missiles and Space Co., Sunnyvale, Calif. Nuclear Space Programs

RIFT RELIABILITY AND MAINTAINABILITY CONSIDERATIONS ARISING FROM NUCLEAR PROPULSION

Jonathan A. Barker, Robert A. Blais, Whitney Hansen, and Lester L. Woodward *In* IEEE 4th Ann. Seminar on Reliability in Space Vehicles [1963] 12 p (See N64-28292 20-17) Available from Western Periodicals Co., 13000 Raymer St., N. Hollywood, Calif.: $6.50

The use of a nuclear reactor in the RIFT Stage Test Program is accompanied by the need to consider problems of radioactivity in design, disassembly, modification, and maintenance. Limitations on accessibility and repairability are imposed by radioactivity from hot captive testing. Inherent reliability and its complement, maintainability, are thus constrained by the difficulties of remotely manipulated operations, personnel exposures, and decontamination procedures. RIFT Program planning encompasses these considerations. Author

N64-28294* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NEW METHODS FOR EVALUATION OF PERFORMANCE RELIABILITY

Dale L. Burrows *In* IEEE 4th Ann. Seminar on Reliability in Space Vehicles [1963] 10 p (See N64-28292 20-17) Available from Western Periodicals Co.,13000Raymer St., N. Hollywood, Calif.: $6.50

A simplified version of an in-flight stage separation problem is considered, and a math model is devised for integrating the performance parameters with their interacting statistical content in such a way as to arrive at the probability of success. Lower stage weight, retrorocket thrust, lower stage cutoff thrust, and separation distance between stages needed to avoid explosion at upper stage ignition were the assumed controlling parameters. The primary purpose of the paper was to review the problem and propose a methodology. No meaningful results were obtained because of lack of sensible statistical input. The analysis served to indicate the nature of a broad problem area that is in much need of theoretical treatment. Author

N64-28300* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

DEVICE FOR REFILLING LIQUID HELIUM CRYOSTATS WITH SMALL LOSS OF RESIDUAL LIQUID HELIUM

D. E. Hegland Repr. from Cryogenics, Apr. 1964 1 p refs
(NASA-RP-279)

A device is described that is especially useful if the transfer tube must be left in the cryostat between transfers and is allowed to warm up. A transfer is begun when the liquid-helium level has dropped below a hole in tube *B*. The initial flow of boiloff gas, resulting from cooling in the transfer tube, is vented through tube *A* (thin-wall stainless steel), the disc at the top of the vent having been removed. The hole prevents the residual liquid from being siphoned into tube *A*. When the transfer tube has cooled, liquid helium collects in tube *A* and subsequently overflows stand-pipe *B* (and the thin-wall stainless steel) into the liquid-helium chamber of the Dewar. The O-ring fitting permits easy removal of the transfer tube from the cryostat. I.v.L.

N64-28321* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DIFFUSION STUDIES OF SEVERAL OXIDATION RESISTANT COATINGS ON MO-0.5Ti MOLYBDENUM ALLOY AT 2,500° F

Bland A. Stein and W. Barry Lisagor Washington, NASA, Aug. 1964 38 p refs
(NASA-TN-D-2039) OTS: $1.00

Results of a study on the diffusion effects of several silicide-base coatings on Mo-0.5Ti molybdenum-alloy sheet are presented. The magnitude of substrate thickness loss due to solid-state diffusion at 2,500° F is presented; this indicates the possible need for diffusion barriers between coating and substrate in some applications. The phase changes in the coatings during exposure at 2,500° F in air were studied to obtain an understanding of coating behavior. The phases that formed were identified by X-ray diffraction techniques. From these identifications, an explanation is given for the superior oxidation protection of one of the coatings. Author

N64-28332* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STUDY OF SEVERAL OXIDATION-RESISTANT COATINGS ON Mo-0.5Ti ALLOY SHEET AT 2,500° F

Donald R. Rummler, Bland A. Stein, and Richard A. Pride Washington, NASA, Aug. 1964 79 p refs
(NASA-TN-D-2040) OTS: $2.00

Results are presented of a study of several silicide-base oxidation-resistant coatings applied to 0.012-in.-thick molybdenum-alloy sheet. The specimens were both continuously and cyclically exposed at 2,500° F in air. The effect of three different types of thermal cycles was investigated. A failure mechanism is proposed to explain the severe reduction observed in the ability of a coating to protect the substrate when thermally cycled. A failure mechanism for the continuously exposed coated specimens is also proposed. The investigation includes the results of X-ray studies and room-temperature mechanical-property tests on the coated specimens. Author

N64-28424 Princeton U., N.J. Plasma Physics Lab.

APPLICATIONS OF STRESS ANALYSIS FOR THE DESIGN OF CERAMIC SEALS

R. Mark and G. Lewin Aug. 1964 24 p refs Presented at the Am. Ceram. Soc., Phila., 17 Sep. 1964
(Contract AT(30)-1238)
(MATT-293)

Stress analysis of typical ceramic to glass or to metal seals such as the butt seal and the washer-sandwich seal is presented. In addition to theoretical investigation, examples are given of experimental analyses—the application of strain gages to a ceramic prototype and the use of three dimensional photoelastic model analysis. Author

N64-28507 Aerojet-General Corp., Azusa, Calif. Structural Materials Div.

DETERMINATION OF EFFECTS OF MATERIALS AND PROCESS VARIABLES ON FILAMENT-WOUND STRUCTURES

B. F. Chester Jul. 1964 36 p ref
(Contract N140(131)-75687B(X))
(QPR-0827-02-2; AD-602279) OTS: $1.50

The primary purpose of this program is the identification and isolation of those materials and process variables that significantly affect the long-term strength of deep-submergence vessels. Sixteen 3.0-in.-inner diameter by 6.0-in.-long glass composite test specimens with 0.375-in.-thick walls have been fabricated, using three promising filament-winding patterns for deep-submergence fabrication (i.e., machine-wrapped 0° longitudinal filaments with a 4H:2L dispersion; hand-laid-up 0° longitudinal filaments with a 2H:1L dispersion; and a machine-wrapped 3.5° longitudinal filament with a 4H:2L dispersion). The data obtained show that the 2H:1L design with a composite stress level of 130 ksi has the best performance. The 4H:2L (0°) and the 4H:2L (3.5°) designs followed with 10% and 25% lower performance, respectively. The test results obtained have indicated that the spread of the composite stress levels is too wide for this program. Ultrasonic data, void content, calculations, and microphotographs from the test specimens tend to support the theory that a high ultrasonic attenuation indicates high void content. The appendixes contain material on the specimen-fabrication process, void-content determination (% vol), and the material and process test specification and methods. I.v.L.

N64-28569 Brunswick Corp., Marion, Va. Defense Products Div.
DEVELOPMENT OF A 1200° F RADOME Interim Engineering Report, 1 Apr.–30 Jun. 1964
V. A. Chase and R. L. Copeland [1964] 41 p refs
(Contract AF 33(657)-11469)
(IER-5; AD-603730)

The work covered includes investigation into the thermal and physical properties of new ceramic matrices. Promising matrices were used to fabricate glass-reinforced laminates for evaluation. The primary criteria used was flexural strength after thermal aging. Additional information is reported on the effect of curing atmosphere on laminate strength. Thermal and mechanical data on glass-reinforced aluminum-phosphate laminates are reported. The final report of the electrical testing of the 64-in. glass-reinforced aluminum phosphate radome is given. This test shows excellent transmission and broadband properties. Author

N64-28570 Union Carbide Corp., Parma, Ohio Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR GRAPHITE
J. M. Criscione, R. A. Mercuri, E. P. Schram, A. W. Smith, and H. F. Volk Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 88 p refs
(Contract AF 33(657)-11253)
(ML-TDR-64-173, Pt. I; AD-604463)

A review of previous work on protective coatings for graphite, a description of several basic factors controlling the oxidation protection of graphite, and a review of existing information on the diffusion of oxygen and carbon through coating materials, and of the volatility, chemical stability, and mechanical compatibility of coating materials is presented. Author

N64-28606 General Motors Corp., Kokomo, Ind. Delco Radio
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND INCREASE THE RELIABILITY OF THE 2N1358A TRANSISTOR Final Engineering Report, Apr. 30, 1962–Apr. 30, 1964
J. G. Kuhns [1964] 231 p refs
(Contract DA-36-039-SC86725)
(AD-603363)

This is a review of the work performed to improve the reliability of the 2N1358A transistor—a TO-36 germanium power device. A total of 17 equipment and/or process modifications of the manufacturing facilities were instituted and are described. There was continuous monitoring of production reliability levels, a series of six milestone proof tests, and development of several special tests. The results of these testing programs are presented. A failure analysis program on the transistor failures generated by the accelerated testing was maintained throughout the total time period. Failure modes and mechanisms were identified, classified, and tabulated. Results of an analytical-empirical surface study program are included. This study encompasses analyses of transistor surface conditions with laboratory instruments, and numerous engineering experiments to determine the influence of various surface treatments. Author

N64-28621 Melpar, Inc., Falls Church, Va.
2000 DEG F POWER WIRE FOR AEROSPACE ENVIRONMENT Quarterly Report, Apr.5–Jul. 5, 1964
[1964] 29 p ref
(Contract AF 33(657)-11046)
(QR-5; AD-602144)

A brazing study was undertaken to produce reliable end seals for power wire systems. The best results were obtained with 99.5% dense alumina end plugs, vacuum brazed under controlled heating, cooling, and cleaning conditions. Studies of the breakdown during the 2,000° F, 1,200-v test showed that breakdown occured over the surface of the ceramic. Small modifications of the present end seal configuration using materials already on hand show promise of overcoming this difficulty. Author

N64-28638 Boeing Co., Seattle, Wash. Aero-Space Div.
MACROLAMINATE PARTICLE DEVELOPMENT Interim Report, Apr. 1–Jun. 1, 1964
F. H. Simpson [1964] 22 p
(Contract NOw-64-0194-f)
(IK-1; AD-602215) OTS: $0.75

Macrolaminate particle development is discussed in terms of studying its geometry, forming methods, sintering, and specimen testing. Macrolaminate particle geometry was investigated by silk-screening, knife-coating, and roll-coating methods. G.D.B.

N64-28674 Atomics International, Canoga Park, Calif.
PROCESS DEVELOPMENT FOR BONDING ZIRCALOY 2 CLADDING TO GRAPHITE MODERATOR
S. K. Lee 1 Aug. 1964 64 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9604)

A process, utilizing copper as an agent to braze Zircaloy 2 and graphite, was developed as a means of stabilizing Advanced Sodium Graphite Reactor (ASGR) moderator cans. The process consists of plasma spraying a controlled amount of copper on the Zircaloy 2, and holding the coated surface in firm contact with graphite. Upon heating above the Zr-Cu eutectic temperature, a molten Zr-Cu alloy forms, which bonds the Zircaloy 2 and graphite together. Bond strength and high-temperature stability were determined by mechanical tests, thermal cycling tests, and high-temperature exposure tests. The effects of the bonding process on the mechanical properties of Zircaloy 2 were also evaluated. Author

N64-28714 United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.

ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Final Report, Phase I, Jul. 1, 1963–Feb. 29, 1964

J. F. Dudenhoefer [1964] 145 p refs
(Contract DA-36-039-AMC-03625(E))
(EBR-136; AD-602054)

The current program status includes these results: (1) The electron-beam welding of 10 materials (Kovar, stainless steel, molybdenum, copper, tantalum, rhenium, tungsten, nickel, titanium, and niobium) was successfully completed. A total of 56 lap-joint configurations were welded. These consisted of 28 bimetallic combinations in two thicknesses each. One-hundred and eighty wire-to-coupon welds were produced. These consisted of the same 10 metals in 90 bimetallic combinations of two thicknesses each. The successful welding of these specimens demonstrates that the electron-beam process can be used to weld materials and thicknesses which are of interest to the electron-tube industry. (2) Weldments involving molybdenum and tungsten are most susceptible to failure in shock, impact-in-tension, and repeated load bending, but apparently are not seriously affected by vibration. All other welded joints do not seem to be affected by shock, vibration, or impact-in-tension. (3) All lap-joint weldments are more susceptible to earlier failure under repeated load bending than the base metal. (4) The electron-beam process can readily drill holes, ranging from 0.0005-in. to 0.125-in. diameter, through copper, tungsten, molybdenum, stainless steel, tantalum, and titanium, in thickness from 0.001-in. to 0.025-in. I.v.L.

N64-28720 Los Alamos Scientific Lab., N. Mex.

MEC-21/7094, A PIPING FLEXIBILITY ANALYSIS PROGRAM FOR THE IBM-7090 AND 7094

James H. Griffin 14 Jul. 1964 196 p refs
(Contract W-7405-ENG-36)
(LA-2929) OTS: $2.75

MEC-21/7094 is a computer program using tensor analysis methods to analyze the flexibility of multiple branch and closed-loop piping systems subject to thermal, uniform, and concentrated loadings, and is also applicable on cryogenic piping systems. All computations are performed in accordance with the requirements of American Standard Code for Pressure Piping. As an incidental feature, the program is also able to solve certain structural problems. It is wirtten in FORTRAN II and will operate on either the IBM-7090 or 7094. The maximum problem size is 99 branches, 99 branch-intersection-points, and/or 999 data points. Each data point may describe one to three elements. Machine time varies between 0.02 and 0.05 min per element, depending on the complexity of the system. The report covers the application of the program and serves as an instruction manual for its use. It includes detailed instructions for preparation of the input data as well as a number of illustrative examples. Author

N64-28791 Varian Associates, Beverly, Mass. Bomac Div.

BL-221 70 Gc MAGNETRON PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 6 Feb.–6 May 1964

Robert C. Sibley [1964] 7 p
(Contract DA-36-039-SC-85974)
(QPR-11; AD-601744)

Five magnetrons were accepted during final qualification testing. Three magnetrons were made to check hot frequency using anodes from available hobs. Parts are nearly complete for pilot production run. Negative results were obtained for tests eliminating hand deburrring and spark machining of the transformer slot. Author

N64-28795 Texas Instruments, Inc., Dallas Semiconductor-Components Div.

PRODUCTION ENGINEERING MEASURE TO INCREASE TRANSISTOR RELIABILITY Final Engineering Report, May 1, 1962–Dec. 31, 1963

3 Mar. 1964 94 p
(Contract DA-36-039-SC-86730)
(Rept.-03-64-12; AD-601956)

Process improvement work was done and reliability testing performed during the later portion. Improvements were installed throughout the process to gain better control on manufacturing steps, and to reduce operator dependency. Process modifications were also made to enhance the effectiveness of operations. Acceptance criteria for both manufacturing and quality control inspection were more specifically defined and tightened. This assures the end product to be more uniform and provides an ability to separate out the mavarick devices contributing to the failure rate. Reliability testing on a total of 2,200 transistor at three power levels—1, 1 1/2, and twice maximum rated power—showed an extrapolated failure rate that is less than 0.01% per 1,000 hr at 25° C with a 90% confidence level. Author

N64-28810 Mare Island Naval Shipyard, Vallejo, Calif. Rubber Lab.

DEVELOPMENT OF METAL LAMINATES WITH HIGH DAMPING CAPACITY Progress Report No. 3

R. M. Antonucci 13 Jul. 1964 44 p refs
(Rept.-94-53; AD-602238)

This report describes techniques developed for the manufacture of flat panels 3 × 4 ft in size and having a net thickness of steel of 3/8 in. The panels consisted of six 1/16-in.-thick layers of mild steel interleaved with 10-mil-thick layers of a Neoprene ILA compound. Various methods of cutting, machining, and forming the panels to desired contours were investigated. It was found that the panels can be cut with a band saw to desired sizes and machined with the usual cutting tools, provided the panels are kept cool during these operations. It was also found that the panels could be bent satisfactorily only with radius dies and then only if the panels were totally enclosed within mating dies. Author

N64-28822 Picatinny Arsenal, Dover, N.J. Ammunition Engineering Directorate

PRODUCTION ENGINEERING OF METAL PARTS FOR LITTLE JOHN ROCKET MOTOR XM26E3 WITH FIN AND FIN BARREL ASSEMBLY

Wilford C. Montross May 1964 35 p refs
(TR-3168; AD-602278) OTS: $1.00

Several components on the production-engineered XM26E3 rocket motor provide a reduction in cost over the corresponding components of the XM26E1 Rocket Motor through savings in tooling, labor, and materials costs. The total estimated cost savings for the various components, which were obtained as a result of this production-engineering study, are given. The estimated complete item costs for the XM26E1 and XM-26E3 metal parts are also discussed. Cost savings for the production-engineered shell assembly are not significant; however, reliability was increased by the elimination of welds. The production-engineered one-piece nozzle eliminates close tolerances required at the mating surfaces between the nozzle and nozzle tip of the two-peice assembly and will eliminate a cause for possible rejects through misalignment of parts. The production-engineered fins show an increase in cost over the original fins; however, they have an advantage in that external disassembly and replacement of fins were made possible. Author

N64-28825 Watervliet Arsenal, N.Y. Benét R&E Labs.
CANDIDATE MATERIALS FOR WHISKERS COMPOSITES
Michael J. Salkind May 1964 41 p refs
(WVT-RR-6411; AD-602132) OTS: $1.25

An analysis was made of candidate materials for whisker composites. The expected strength-to-weight ratio of composites of 19 matrix materials with different fiber materials as a function of fiber content was calculated. The availability, bondability, and thermal expansion properties of candidate materials are discussed. Author

N64-28837* Pyrogenics, Inc., Woburn, Mass.
A STUDY OF THE USE OF VAPOR AND VACUUM DEPOSITION TECHNIQUE FOR THE DEVELOPMENT OF HIGH STRENGTH FILAMENTARY MATERIALS Quarterly Progress Report No. 1, 22 Apr.–22 Jul. 1964
J. R. Bedell 15 Aug. 1964 35 p refs
(Contract NASw-927)
(NASA-CR-58696) OTS: $3.60 ph

A reference survey is presented, indicating types of information available from various sources and designating, where possible, the pages upon which such information can be found. Surveillance of this literature indicated that the strengths of whisker coatings and massive pyrolytic graphite deposits are strongly influenced by three parameters—substratum surface, specimen thickness, and subsequent treatment (i.e., annealing, and hot and cold work). Author

N64-28958* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS
K. N. Mathes 15 Jun. 1964 60 p
(Contract NAS8-2442)
(NASA-CR-58502) OTS: $5.60 ph

The development and evaluation of stranded round wire and of ribbon cable that is particularly suitable for application at cryogenic temperatures is discussed. The electrical properties of two film dielectrics, H-film (aromatic polyimide film) and FEP (polyfluoroethylene–propylene) teflon, were evaluated at high temperatures as well as at cryogenic temperatures. The various results are divided into three areas of presentation: electrical characteristics of FEP and H-film; physical and electrical properties of stranded round cable treated with FEP and H-film; and physical and electrical properties of ribbon cable treated with FEP, and H-film. P.V.E.

N64-28962* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
DEVELOPMENT OF LOW TEMPERATURE DIELECTRIC COATINGS FOR ELECTRICAL CONDUCTORS Seventh Quarterly Report
K. N. Mathes 15 Apr. 1963 35 p
(Contract NAS8-2442)
(NASA-CR-58539) OTS: $3.60 ph

The continuing evaluation of the effect of thermal aging on the performance of wire insulation at room and cryogenic temperatures is reported. Mandrel flexibility and dielectric measurements are summarized for all of the wires after aging the specified length of time in vacuum and air at 120° C and in air at 250° C. The results indicate that the effects of thermal aging can be determined by measuring changes in flexibility, voltage breakdown, and dissipation factor. Qualitative correlation between these different methods is demonstrated. Measurements have also been made in liquid helium and, in some cases, in liquid nitrogen. Preliminary data on wires after exposures to high humidity are included, as well as flexibility results for several-ribbon-cable immersed in liquid helium. New test equipment for the dielectric evaluation of cryogenic liquids is described. M.P.G

N64-29000* IIT Research Inst., Chicago, Ill. Metals and Ceramics Div.
DEVELOPMENT OF A METHOD FOR CLEANING FLEXIBLE STAINLESS STEEL LINES Final Report, 27 Aug. 1963–27 Apr. 1964
Howard T. Francis 12 Jun. 1964 28 p
(Contract NAS8-11089)
(IITRI-B6017-8; NASA-CR-58585) OTS: $2.60 ph

A method is described for removing the outermost layers of metal from flexible metal components used in booster vehicle fuel and oxygen lines. While pickling, bright-dipping, passivating, and similar treatments used for stainless alloys can be applied readily to small parts, this type of treatment for very large (2- and 3-ft diam) ducts is physically impractical. The new method employs a mild electrolyte (20% sodium chloride, for example) applied to the metal surface through a metal jet. A d.c. voltage is applied between the jet and the workpiece (the latter being positive) so that continuous dissolution occurs where the electrolyte jet strikes. The stream is played on the surface with a sweeping motion, allowing reasonably uniform current distribution and controlled "deplating" of the surface. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-27885* Lockheed-Georgia Co., Marietta Lockheed Nuclear Products
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 13, Jan.–Mar. 1964
C. A. Schwanbeck May 1964 42 p
(Contract NASw-114)
(NASA-CR-56673; ER-6929) OTS: $4.60 ph

Room temperature, out-of-pile testing was completed on sets of three tensile and three tensile-notch specimens for each alloy added to the screening program after the completion of the major room-temperature testing program. In-pile testing, after exposure to an integrated dose of 1×10^{17} nvt fast (> 0.5 Mev) neutrons, was continued using sets of three specimens for each type of alloy and test. These have been completed for four alloys—AISI Types 304 and 347 stainless steels and titanium alloys 55A and 5% aluminum, 2-1/2% tin. Temperature correlation and refrigeration control data were obtained from an instrumented aluminum alloy specimen to assure adequate temperature control of aluminum alloy test samples. Author

N64-27895* Aluminum Co. of America, Cleveland, Ohio Development Div.
FABRICATION OF VARIOUS 2219 ALUMINUM ALLOYS
Final Report
Paul L. Mehr 24 Apr. 1963 67 p
(Contract NAS8-5143)
(NASA-CR-58029) OTS: $6.60 ph

The purpose of this investigation was to study production methods for fabricating number of 2219-aluminum-alloy forged fittings that will be used in the tankage system of the advanced Saturn booster. These fittings can be produced from various forms of forged material, depending upon the quantity and delivery requirements, mechanical properties required, and desired grain orientation. Alloy 2219 is a heat-treatable aluminum alloy. Its mechanical properties can be improved by the use of a solution heat treatment, quench, and artificial aging treatment. The introduction of controlled amounts of cold work after solution heat treatment accelerates the response to precipitation heat treatment, resulting in a further improvement in mechanical properties. The level of mechanical properties available in a given part is therefore quite dependent upon the method of processing. Author

N64-27926* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SURFACE FAILURE OF TITANIUM CARBIDE CERMET AND SILICON CARBIDE BALLS IN ROLLING CONTACT AT TEMPERATURES TO 2000°F
Richard J. Parker, Salvatore J. Grisaffe, and Erwin V. Zaretsky Washington, NASA, Aug. 1964 23 p refs
(NASA-TN-D-2459) OTS: $0.75

The five-ball fatigue tester was used to study the behavior of nickel-bonded titanium carbide cermet and self-bonded silicon carbide balls under repeated stresses applied in rolling contact. Test conditions were 80° and 700° F, a contact angle of 20°, and a shaft speed of 950 rpm with a mineral oil lubricant. The nickel-bonded titanium carbide–cermet balls were tested at maximum Hertz stresses from 400,000 to 550,000 psi, while the silicon carbide balls were tested at maximum Hertz stresses from 300,000 to 400,000 psi. Failure appearance for both materials was unlike the fatigue pits found in bearing steels and a crystallized-glass ceramic. However, the pits were similar to those found in alumina balls (both hot pressed and cold pressed and sintered). A typical failure was a shallow eroded area less than 1-mil deep for the titanium carbide cermet and 3 to 5 mils for the silicon carbide. These failures evolved by progressing slowly from a very small pit to one spanning the running track width. Tests at 80° F with mineral oil lubrication over a range of stresses show that life varies inversely with stress to a power that ranges from 9.7 to 10.5 for the titanium carbide cermet and from 6.9 to 8.6 for the silicon carbide. The load capacity of the titanium carbide and silicon carbide balls was 3% and 1%, respectively, that of typical bearing steel balls, and 41% and 18%, respectively, that of hot-pressed alumina balls. Author

N64-27952 Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.
THE INFLUENCE OF SECTION SIZE ON THE MECHANICAL PROPERTIES AND FRACTURE TOUGHNESS OF 7075-T6 ALUMINUM, 6Al-6V-2sn TITANIUM, AND AISI 4340 STEEL
Thomas S. De Sisto, Frank L. Carr, and Frank R. Larson Feb. 1964 19 p refs
(AMRA-TR-64-05; AD-600846) OTS: $0.50

The influence of section size on mechanical properties, yield strength, tensile strength, elongation, reduction of area, notched tensile ratios, and fracture toughness was determined for 7075-T6 aluminum, 6Al-6V-2Sn titanium, and AISI 4340 steel. The tests were made on smooth tension specimens with diameters from 0.113 to 3.57 inches, and sharply notched specimens with diameters from 0.160 to 5.05 inches. The tensile fracture topography of the smooth and notched specimens is illustrated and discussed. The data show that yield and tensile strengths are not changed appreciably by increasing section size, but ductility and toughness properties are affected. Author

N64-27957 Harry Diamond Labs., Washington, D.C.
A LOW-DENSITY ALUMINUM-CERAMIC MATERIAL
R. R. Palmisano and J. Drager 5 Jun. 1964 19 p refs
(TR-1229; AD-602413)

An evaluation was made of the physical properties of a newly developed low-density aluminum–ceramic material. The low density is achieved by filling a casting mold with minute hollow ceramic spheres and forcing molten aluminum into the mold. Since the hollow ceramic spheres are of very low density and occupy an appreciable volume within the resulting mixture, an aluminum alloy results that has about one-half the density of aluminum and is inexpensive to produce. Examination of the physical properties of this filled-aluminum material shows that it possesses sufficient integrity for use as a structural material. A comparison of its physical properties with those of magnesium KIA and aluminum A356 is presented. Author

N64-27969 Battelle Memorial Inst., Columbus, Ohio
EFFECT OF SIMULATED IN-REACTOR ANNEALING ON AN IRRADIATED TYPE 347 STAINLESS STEEL PRESSURE TUBE
Mihkel Kangilaski, Frederic R. Shober, and John E. Gates 31 Jul. 1964 37 p refs
(Contract W-7405-ENG-92)
(BMI-1683) OTS: $1.00

The effects of a simulated in-pile anneal on the mechanical properties of an irradiated Type 347 stainless steel pressure tube were studied. The effects of a subsequent 1-hr anneal at 1,800° F in an annealing furnace were also investigated. The pressure tube operated in the ETR at a maximum temperature of approximately 700° F in a stressed condition and accumulated a fast-neutron (>1 Mev) exposure of about 6.6×10^{21} nvt. Tests were carried out at 25° and 400° C. Hardness tests at 25° C showed a wide range of hardness values, 75 to 48 Rockwell A, indicating a nonuniform annealing pattern resulting from the simulated in-reactor anneal. The results of tension tests at 25° and 400° C gave ultimate strengths of 90,000 and 65,000 psi, 0.02% offset yield strengths of 50,000 and 30,000 psi, total elongations of 50% and 25%, and reductions of area of 70% and 60%, respectively, after the anneal. These results are similar to those obtained in a previous investigation following a 1-hr anneal at 1,000° F, and indicate that an in-reactor anneal will remove an appreciable portion of the radiation-induced property changes. A subsequent furnace anneal at 1,800° F produced additional recovery of radiation-induced property changes. Author

N64-28000 Brush Beryllium Co., Cleveland, Ohio
BERYLLIUM: SURFACE TREATMENT AND COATINGS
W. W. Beaver and A. J. Stonehouse Aug. 1963 33 p refs
Presented at a Short Course on Beryllium, its Properties and Appl., Calif. U., Los Angeles, 4–8 Mar. 1963
(BBC-TR-329)

Surface treatments and coatings are being applied to beryllium at the present time primarily to improve the base corrosion resistance of the metal, to improve mechanical properties and

wear resistance, and to facilitate joining techniques such as brazing. The beryllium surface is normally covered with a nonporous, protective oxide film about 100 A thick. This limiting thickness is reached after 2 hours' exposure to the atmosphere at room temperature. At elevated temperatures, oxidation proceeds at a parabolic rate which is quite slow to the range of 1,475° to 1,500° F after which sharp increases in the oxidation rates occur. This generalization is valid for short time exposure only. With long time exposure, breakaway can occur leading to catastrophic oxidation at temperatures below 1,500° F. A major portion of the surface treatment and coating technology for beryllium is concerned with means to remove the oxide coat in order to achieve good bonding with the metal. A second characteristic of the beryllium surface is its susceptibility to damage by machining or other working techniques. Author

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N64-28002 Brush Beryllium Co., Cleveland, Ohio
CORROSION AND PROTECTION OF BERYLLIUM METAL
A. J. Stonehouse and W. W. Beaver Dec. 1963 32 p refs Presented at the Aerospace Metals Symp., Chicago, 9–13 Mar. 1964
(BBC-TR-335)

This survey of corrosion and protection of beryllium discusses aqueous corrosion, atmospheric corrosion, corrosion by high-temperature gases, liquid-metal corrosion, minimizing corrosion of unprotected beryllium, the protection of beryllium with anodized coatings, and other protective systems. G.D.B.

N64-28017 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE, 1964
Russell W. Dayton and Ronald F. Dickerson 1 Jul. 1964 48 p
(Contract W-7405-ENG-92)
(BMI-1674-(DEL)) OTS: $1.00

Research efforts are reported in the following areas: "Reactor Materials and Components"; "Studies of Fuels"; "General Fuel-Element Development"; "Radioisotope and Radiation Applications"; "Coated-Particle Fuel Materials"; "Corrosion Studies of the Fluoride-Volatility Process"; "Long-Term Creep-Rupture Program on SAP Alloys"; "Mechanical Properties of Zirconium Alloys"; "Fission-Product Deposition Studies"; "Gas-Cooled Reactor Program"; and "Development of Small Radioisotopic Power Sources." R.T.K.

N64-28051* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio TRW Electromechanical Div.
GENERATION OF LONG TIME CREEP DATA OF REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Fourth Quarterly Report, Mar. 26–Jun. 26, 1964
J. C. Sawyer and C. H. Philleo 1 Jul. 1964 44 p
(Contract NAS3-2545)
(NASA-CR-54123) OTS: $4.60 ph

The first of 14 ultra-high-vacuum creep furnaces has been installed and operated. The furnace, vacuum system, and auxiliary equipment for controlling and measuring temperature, and for measuring strain are described in detail. Testing was initiated on columbium FS-85 alloy at 2,000° F. After 300 hours a total extension of 0.025% was produced at an applied stress of 4,000 psi. Author

N64-28061 Weapons Research Establishment (Australia) Australian Defence Scientific Service
TANTALUM AS A DIFFUSION BARRIER BETWEEN TUNGSTEN AND GRAPHITE
J. R. Baxter Aug. 1962 21 p ref
(WRE-TN-CPD-54)

The use of a thin layer of tantalum between tungsten and graphite to reduce the rate of diffusion of carbon into tungsten was investigated over the temperature range 2,350° to 2,800° C. It was established that tantalum is rapidly carburized, but carbon does not diffuse rapidly through the carburized layer. A tantalum layer 0.005-in. thick is adequate to enable the interface to be held at a maximum temperature of 2,750° C for 5 to 10 minutes. Failure of the diffusion barrier occurs rapidly at approximately 2,800° C. Author

N64-28085* General Electric Co., Cincinnati, Ohio Missile and Space Div.
MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report No. 4, Jan. 22–Apr. 22, 1964
R. G. Frank, ed. [1964] 43 p refs
(Contract NAS3-2534)
(NASA-CR-54113) OTS: $4.60 ph

Among the items reported are these: (1) Corrosion and dimensional-stability test specimens for 13 of the 14 candidate materials were ordered, and procurement of the hot hardness, thermal expansion, and compression specimens was initiated. (2) Of 100 lb of *K* received, 24.5 lb were transferred to a modified 25-lb capacity shipping container and outgassed at 315° to 450° F in preparation for repurification. (3) Fabrication of all major components of the isothermal-capsule test facilities and the dimensional-stability test facilities was completed. One of the five isothermal-capsule test facilities was assembled and instrumented with 6Nb-1Zr alloy test capsules containing *K*, and the high-vacuum chamber was evacuated in preparation for the checkout tests. (4) The Chevenard dilatometer was modified to enable the instrument to be evacuated and backfilled with high-purity He. (5) Several design changes were incorporated in the liquid *K* friction-and-wear tester. (6) A heat-transfer analysis was initiated for the final design of the liquid *K* test rig. Critical shaft-speed calculations of the final design show a ratio of 2.03 between the first critical and maximum test speed (Ncr/4800 rpm). (7) The facility requirements for the liquid *K* friction-and-wear tester have been finalized. I.v.L.

N64-28087* Atomics International, Canoga Park, Calif.
SOLUBILITY AND DIFFUSION STUDIES OF ULTRA PURE TRANSITION ELEMENTS IN ULTRA PURE ALKALI METALS Fourth Quarterly Report, Mar. 29–Jun. 27, 1964
R. L. Mc Kisson, R. L. Eichelberger, G. R. Argue, and J. M. Scarborough 10 Aug. 1964 25 p refs
(Contract NAS3-4163)
(NASA-CR-54094; A1-64-54094) OTS: $2.60 ph

Progress in the current program includes the following: (1) The environmental test system has been delivered and accepted. (2) All of the purchased auxiliary equipment has been delivered and assembled into functioning test components. (3) Two single crystals, each, of Nb, Mo, and Ta are in the process of electrochemical machining to form single-crystal crucibles. Two high-purity Fe crucibles are being prepared for use in the first series of solubility tests. (4) Chemical-analysis techniques for determining the impurities in sample materials have been tested. Verifications of these techniques, at the low impurity levels expected in the single-crystal materials, have proved troublesome in that these crystals are, in many cases, purer than the usual reference standards. I.v.L.

N64-28093* National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
THE EFFECTS OF COMBINED PRIOR STRESS AND ATMOSPHERIC CORROSION ON THE FATIGUE LIFE OF ALUMINUM ALLOYS

Herbert A. Leybold Washington, NASA, Aug. 1964 18 p refs (NASA-TN-D-2359) OTS: $0.50

Fatigue tests were conducted on 300 vibrating cantilever sheet bending specimens after the specimens were subjected to atmospheric stress corrosion for varying periods of time up to 4 years. Specimens of 2024-T3 and 7075-T6 aluminum alloy in both the bare and clad forms were tested. For comparison, companion tests were conducted indoors. The results indicate that the constant stresses applied to the specimens during the stress-corrosion portion of the investigation had no significant effect on the fatigue life. Most of the reduction in fatigue life due to atmospheric exposure occurred during the first year. The fatigue lives of 7075-T6 and 2024-T3 specimens in the bare condition were shortened by factors of 4.0 and 3.5, respectively, and the life of the 7075-T6 material in the clad condition was shortened by a factor of 1.5. No factor could be determined for the 2024-T3 clad material because of the scatter of the test results. Author

N64-28095 Tokyo U. (Japan) Aeronautical Research Inst.
SINTERING AND SOME PROPERTIES OF IRON-BONDED TITANIUM CARBIDES
Eiji Niki, Shiro Kohara, and Kiyohiko Tatsuzawa Mar. 1964 13 p refs *Its* Rept. 387(Vol. 29, No. 9)

A study has been done on the iron-bonded titanium carbides. Mixtures of titanium carbide and iron powders in various compostions (10-, 20-, 30-, 40-, 50-, 60-, 70-, 80-, and 90-pct iron by weight) were prepared. Linear shrinkage of compact was observed during sintering, and optimum temperature for sintering was determined. Then test specimens were sintered, and density, transverse rupture strength, and hardness were evaluated on the specimens in three different conditions—as sintered, quenched, and tempered. Author

N64-28110 Argonne National Lab., Ill. Metallurgy Div.
THE U-Pu-C TERNARY PHASE DIAGRAM BELOW 50 ATOMIC PERCENT CARBON Final Report
S. Rosen, M. V. Nevitt, and A. W. Mitchell Mar. 1964 110 p refs
(Contract W-31-109-ENG-38)
(ANL-6435)

The U-Pu-C ternary phase diagram for the composition range from 0 to ~50 at. % carbon and for temperatures below 635° C has been constructed from metallographic, X-ray diffraction, and melting-range data. Isothermal sections at 400°, 570°, and 635° C are presented, and certain fourphase reactions are outlined. Uranium monocarbide forms a complete series of solid solutions with plutonium monocarbide. The metal–carbon stoichiometry of the monocarbide is influenced by the uranium–plutonium ratio. The variation of lattice parameter with composition for binary plutonium–carbon alloys was determined, and was used to define portions of the low-carbon boundary of the PuC phase field. Metallographic observations of cast alloys show that a transition in the microstructures occurs between uranium-rich alloys, which show a homogeneous carbide phase, and plutonium-rich alloys, which show a cored carbide phase. Unique microstructural characteristics are associated with the preference of the Pu_3C_2 phase to grow as platelets in its peritectoidal formation, rather than as an interfacial envelope surrounding the PuC reactant. Author

N64-28112 Morgan Crucible Co., Ltd., London (Gt. Brit.)
LIST OF LABORATORIES IN THE UNITED KINGDOM ACTIVE IN RESEARCH ON CONDENSED PHASES AT HIGH TEMPERATURE
K. G. Mc Whirter, comp. Basle, Intern. Union of Pure and Appl. Chem., 1 Jan. 1964 15 p

N64-28124 Battelle Memorial Inst., Columbus, Ohio
OXIDE-MATRIX DISPERSIONS UTILIZING COATED-PARTICLE FUELS
M. Clifford Brockway, Donald J. Bowers, and Winston H. Duckworth 14 Jul. 1964 24 p refs
(Contract W-7405-ENG-92)
(BMI-1675) OTS: $0.50

Major problems associated with dispersing oxide vapor-coated fuel particles in oxide matrices were solved by pelletizing techniques. Damage to coated particles during mixing and compacting of fuel dispersions was minimized. Coating failures caused by matrix shrinkage during sintering or by matrix crack propagation were avoided by incorporating void-producing burnout layers around the dispersed coated particles. An unresolved problem was the thermal degradation of vapor coatings during matrix sintering to 1,600° C. As a result, the most retentive dispersions released several hundred ppm of Xe^{133} during heating after neutron activation, compared with the release of only a few ppm exhibited by undispersed coated fuel. The proposed solution is to utilize a BeO matrix powder sinterable at lower temperatures. Author

N64-28125 Battelle Memorial Inst., Columbus, Ohio
THORIUM AND THORIUM-URANIUM COMPOUNDS AS POTENTIAL THERMAL BREEDER FUELS
Neal M. Griesenauer, Martin S. Farkas, and Frank A. Rough 28 Jul. 1964 35 p refs
(Contract W-7405-ENG-92)
(BMI-1680) OTS: $0.75

The compounds Th_2Al, ThB_4, $ThBe_{13}$, ThC, ThC_2, Th_3Si_2, and ThSi with and without additions of their uranium counterparts, were prepared by arc casting. Microstructural studies showed that with the exception of the aluminide, the uranium substituted for the thorium in solid solution in the compounds. Oxidation tests in dry air and CO_2 up to 540° C indicated greatest oxidation resistance by the borides and beryllides; however, above 540° C the beryllides exhibited rapid oxidation in dry air. In corrosion tests of the compounds in NaK at 650° C, Santowax R at 350° C, and water at 90° C the borides and beryllides were not attacked. Thermal conductivity and expansion were determined on the monocarbide, dicarbide, tetraboride, and beryllide containing 10 mole % of their uranium counterparts. Compression tests and hardness measurements showed that (90Th-10U)C and (90Th-10U)B_4 have nil-ductility strengths greater than 67,000 psi at 980° C. Compatibility tests utilizing the monocarbide, dicarbide, tetraboride, and beryllide containing both 10 and 20 mole % of their uranium counterpart versus potential cladding materials revealed that the beryllides were the most reactive of the compounds tested. Author

N64-28132 European Atomic Energy Community, Brussels (Belgium)
SOME OBSERVATIONS ON ANNEALED AND ION BOMBARDED SAP FOILS
E. Ruedl and Erika Staroste Joint Nucl. Res. Center, Ispra Estab. (Italy), Jun. 1964 24 p refs Presented at Convegno Sui Metalli non Fissili Nei Reattori Nucl., Bologna, 16–18 Dec. 1963
(EUR-1833.e) Available from Belg. Am. Bank and Trust Co., N.Y., account no. 22.186: 40 Belg. Fr.

Thin foils of an Al/4% Al_2O_3 SAP alloy, prepared by rolling, were investigated by means of electron diffraction and transmission microscopy. Both annealed and ion bombarded foils were examined. The annealed foils showed plate-shaped particles of varying size distributed in the matrix. The plates were probably monocrystals of cubic alumina and generally had their {111} flat face in contact with {100} aluminum matrix planes. No impurity precipitates could be detected.

The plates could be imaged either by << structure factor >> contrast or strain contrast. Moving dislocations were either stopped by the plates or passed midway by cross-slip. Thirty kev H^+ and He^+ ions produced damage in the form of a dense dislocation tangle. One annealing at about 400° C gas bubbles were formed, which behaved differently depending on whether they were filled with hydrogen or helium. The dislocations annealed out only near the melting point. Author

N64-28143 British Welding Research Assn., Cambridge (Gt. Brit.)
INVESTIGATION OF THE EFFECT OF COMPOSITION ON WELD METAL SUSCEPTIBILITY TO COLD CRACKING Final Technical Report, 1 Jan.–31 Mar. 1964
F. Watkinson and R. G. Baker Apr. 1964 38 p
(Contract DA-91-591-EUC-2864; BWRA-C59)
(C59/16/64; AD-442232)

Single-run and multirun test weld deposits were made using high-strength electrodes of different alloy types. Both notched tensile specimens and dilatometer specimens were machined from these deposits. The tensile specimens were used to determine the susceptibility to hydrogen cold cracking. Dilatometer specimens were used to determine the transformation characteristics in continuous cooling in the high-speed dilatometer. Results of investigations indicate the following: (1) Chromium appears to increase hardenability more than nickel and molybdenum; that is, it would appear to make it easier to transform to acicular microstructures showing enhanced susceptibility to cold cracking. (2) The higher the nominal strength of the weld metal, the greater is the risk of forming susceptible acicular microstructures, generally speaking. (3) Considerable susceptibility to cold cracking exists where twinned martensite is present. The susceptibility is considerably less where the microstructure consists mainly of low-carbon autotempered martensite with some fine lamellar bainitic structure. In wrought materials, the susceptibility increases with increasing proportions of the fine lamellar bainitic structure. Coarse lamellar bainitic structures would appear to have a low susceptibility. I.v.L.

N64-28148 California U., Berkeley Metal Processing Lab.
VISIOPLASTICITY Progress Report, 6 Feb.–31 May 1964
T. Kadioglu, A. Shabaik, and E. G. Thomsen Jun. 1964 8 p refs
(Contract NOw-63-0564-d)
(PR-1; AD-424108)

The present project has as its objective the refinement of the visioplasticity technique and its application to a wider variety of forming problems of which the rolling process takes a leading position. The possibility of predicting the final structure of the deformed material was explored, and the determination of the velocity field was refined. Author

N64-28160 Rensselaer Polytechnic Inst., Troy, N.Y.
STRESS CORROSION CRACKING Interim Technical Report
W. D. Greene and G. Judd 10 Jun. 1964 201 p refs
(Contract DA-30-069-ORD-3077)
(ITR-4; AD-442235)

The relationship between dissolution kinetics and resistance to pitting corrosion was investigated using electrochemical measurements. The ratio of dissolution rates in the presence and absence of chloride ion is inversely proportional to pitting resistance. The above concepts were used to accurately predict the relative pitting tendencies of austenitic stainless steels, Hastelloy C, and titanium. It is suggested that this method may be used as a basis for developing new alloys resistant to pitting attack. Author

N64-28169 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF CONTACT CORROSION IN LABORATORY AND NATURAL ATMOSPHERIC CONDITIONS
I. L. Rozenfelid, T. I. Pavlutskaya, and L. M. Lapides 14 Feb. 1964 31 p refs Transl. into ENGLISH from Tr. Inst. Fiz. Khim., Akad. Nauk SSSR (Moscow), no. 8, 1960 p 155–172
(FTD-MT-63-124; AD-602562)

A survey is presented of electrode-corrosion investigation. A general conclusion from all experimental material, both in the laboratory and in natural conditions, consists in the fact that the influence of contact on the speed of metal corrosion in atmospheric conditions is significant. This is explained by the concentration of corrosion, due to the small range of contact, directly at the borders of the metals in contact. The speed of contact corrosion, in turn, depends greatly on the composition of the atmosphere. The susceptibility of various alloys and metals to contact corrosion and methods of determining contact corrosion are discussed. I.v.L.

N64-28225 Du Pont de Nemours (E. I.) and Co., Baltimore, Md.
COLUMBIUM "H" SECTION PROGRAM. PHASE I: EXTRUSION. PHASE II: DRAWING Interim Report, 1 Jul.–1 Oct. 1963
E. V. Peterson Wright-Patterson AFB, Ohio, AF Materials Lab., [1963] 31 p refs
(Contract AF 33(657)-11293)
(IR-1; AD-432447)

Phase I goal is the extrusion of D-43 (Cb-10W-1Zr-0.1C) and Cb-752 (Cb-10W-2.5Zr) "H" sections, of specified size, with section thicknesses of 0.060-in., and lengths of at least 20 ft. Two 8-in.-diam ingots of each alloy were melted, converted to billets, and extruded to 3.7-in.-diam stock. Nine 3.4-in.-diam billets were extruded to "H" sections with thicknesses of 0.187 in. and 0.125 in. (extrusion ratios of 12.4:1 and 18.2:1), from 3,400° F. The results are reported. Phase II goal is the drawing of extruded "H" sections of the above alloys to specified size, with section thicknesses of 0.040 in., and lengths of at least 20 ft. Die designs have been made, and general equipment requirements for drawing the "H" sections were studied. Author

N64-28245 Oak Ridge National Lab., Tenn.
PREPARATION AND EVALUATION OF VAPOR-DEPOSITED TUNGSTEN
R. L. Heestand, J. I. Federer, and C. F. Leitten, Jr. Aug. 1964 36 p refs
(Contract W-7405-ENG-26)
(ORNL-3662) OTS: $1.00

Vapor deposition of refractory metals by pyrolitic or chemical reduction of the metal halides is gaining recognition as an alternate fabrication technique. For this reason, vapor deposition of tungsten was investigated as a possible process for fabricating both intricate shapes and intermediate products for subsequent working. In contrast to the extensive equipment required in the commercial production of tungsten, inexpensive equipment of a simple nature was used in this investigation. Author

N64-28248 Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center
INTERMETALLIC COMPOUNDS IN MAGNESIUM-RICH MAGNESIUM-ALUMINUM-ZIRCONIUM ALLOYS
R. L. Crosby and L. W. Higley, Jr. 1964 17 p refs
(BM-RI-6498)

Magnesium-rich magnesium-aluminum-zirconium alloys in the cast and in the extruded and heat-treated condition were studied to identify the phases present and to determine phase distribution. In cast alloys, two intermetallic compounds were identified—$ZrAl_2$ by X-ray diffraction; and $Mg_{17}Al_{12}$ by microscopic observation. Based on microscopic comparisons between the known phases in the cast structures and the phases in the structures of extruded and heat-treated rods, $ZrAl_2$ and $Mg_{17}Al_{12}$ were identified in the structure of the latter. The presence of these intermetallic compounds in rod specimens could not be confirmed by X-ray diffraction. $ZrAl_2$ was observed in the structure of extruded and heat-treated rod specimens containing as little as 0.01 weight-% zirconium. The presence of aluminum restricts the solubility of zirconium in magnesium because of the strong tendency to form $ZrAl_2$. This intermetallic compound segregated in clusters of small particles in the matrix of cast alloys, and only slight improvement in distribution was noted when the alloying techniques were varied. Author

N64-28251 General Electric Co., Cincinnati, Ohio Advanced Technology Services

HIGH TEMPERATURE MATERIALS PROGRAM Progress Report No. 38, Part A, May 15–Jul. 15, 1964

19 Aug. 1964 37 p refs
(Contract AT(40-1)-2847)
(GEMP-38 A) OTS: $1.00

The current program status includes the following: (1) An analysis of the lattice expansion data for BeO led to an equation for the diffusion of interstitial defects and indicated an interstitial migration energy, during irradiation, of about 18 kcal. (2) Autoradiographic and anodization studies were initiated on tantalum samples containing Kr^{85}, which was introduced by the glow-discharge process. (3) The BeO-fuel elements containing 8.5 to 11.5 volume percent UO_2-ThO_2-Y_2O_3 showed little or no UO_2 loss in 1,000-hour fuel retention tests at 1,200°, 1,300°, and 1,400° C in air; those fueled with UO_2-ThO_2 consistently lost more fuel. Fuel elements fueled with 25 volume percent UO_2-ThO_2-Y_2O_3 showed no UO_2 loss in 660 hours at 1,200° C. After 450 hours at 1,200° C, in flowing He, fuel elements fueled with UO_2-ThO_2 and UO_2-ThO_2-Y_2O_3 had insignificant weight changes, indicating no loss of UO_2. (4) Experimental results from fueled BeO specimens sintered at 1,675° or 1,800° C indicate that the higher sintering temperature increases the initial oxidation rate and decreases fuel loss in Y_2O_3-containing specimens. (5) Compressive creep rates for BeO fueled with 25 volume percent UO_2-ThO_2-Y_2O_3 are higher than predicted by the Nabarro–Herring model at temperatures above 1,300° C. I.v.L.

N64-28256 Atomic Energy of Canada Ltd., Chalk River, Ontario

ZIRCALOY-2 CLAD UO_2 FUEL ELEMENTS IRRADIATED TO A BURNUP OF 10,000 MWd/TONNE U

R. D. Mac Donald and G. W. Parry Jan. 1964 50 p refs
(CRFD-1178; EXP-NRX-2906; AECL-1952) Available from Atomic Energy of Canada Ltd., Chalk River: $1.50

Ten Zircaloy-2 sheathed uranium oxide elements were irradiated to a maximum burnup of 10,000 Mwd/t U in the pressurized water loops of the NRX reactor. All elements were intact at the finish of the test except for one specimen in which corrosion of a small inclusion in the top weld bead caused failure. Final dimensions of the elements were almost unchanged from the preirradiation measurements; however, most diameters had expandad by as much as 0.003 in. midway through the test when the heat outputs of tha elements were at their highest. The ZrO_2 film was thicker and the percent hydrogen uptake was smaller than for unirradiated Zircaloy-2 exposed in autoclaves. The ultimate tensile strength of the irradiated Zircaloy increased 33%, but the ductility of the material was reduced. Author

N64-28269 Centre National de Recherches Metallurgiques, Liege (Belgium)

USE OF A NON-DESTRUCTIVE TESTING METHOD IN THE STUDY OF EARLY FATIGUE DAMAGE

R. Salkin *In* Italy. Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 273–285 refs
(See N64-28257 20-33)

Dynamagnetic tests were carried out on steel specimens during low-frequency tension–compression fatigue, in order to investigate structural modifications occurring during the first thousand cycles of fatigue. Various high-strength steels were subjected to continuous observation of their cycle-to-cycle magnetostrictive response to mechanical loading, using a coil surrounding the specimen and connected to a recorder. The results obtained are representative of a more and more hindered motion of Weiss domains. Relation to fatigue damage can be established in a comprehensive way through the assumption of a breaking up of domains when slip bands appear. Author

N64-28312* Michigan U., Ann Arbor

THE MECHANICAL PROPERTIES AT 800°, 1000°, AND 1200°F OF TWO SUPERALLOYS UNDER CONSIDERATION FOR USE IN THE SUPERSONIC TRANSPORT

T. M. Cullen and J. W. Freeman Washington, NASA, Sep. 1964 60 p refs
(Grant NsG-124-61)
(NASA-CR-92) OTS: $1.50

René 41 and Waspaloy were each studied in two conditions of prior treatment to evaluate the maximum temperature at which they exhibited sufficient levels of creep strength, rupture strength, and resistance to the presence of sharp edge-notches for use in the SST. It was determined that the upper use temperature of these alloys is limited by their behavior in the presence of sharp edge-notches and stress concentrations. The sharp notches were used to simulate cracks in the materials. The alloys exhibited satisfactory resistance to the notches and the stress concentrations at 800° F but not at 1,000° or 1,200° F. The sensitivity of the alloys to notches and stress concentrations was related to their creep resistance in the temperature range from 1,000° to 1,200° F. Author

N64-28313* Frankford Arsenal, Philadelphia, Pa.

CELLULAR ALUMINUM FOR USE IN ENERGY DISSIPATION SYSTEMS

S. Lipson Washington, NASA, Sep. 1964 37 p ref
(NASA-CR-93) OTS: $1.00

On the basis that the objectives of this investigation were to develop cellular metal structures having high load-carrying capacity, low loading ratio values, and maximum compressiblity, the following canclusions are drawn: (1) Cellular cylinders of 7075-T6 material having uniform cell size and appropriate load deformation (l/d)ratios can provide for at least 15,000 ft-lb/lb of energy dissipation when the cylinder height has been reduced by 70%. (2) High-strength compositions heat treated to optimum strength levels offer the best promise for dissipation of energy at relatively constant levels of loading. (3) Uniform cell size in the cellular structure favors uniform loading through the compressive deformation of the material. (4) High l/d ratios (more than 1.5) result in columnar instability and early catastrophic failure of the material. Author

N64-28399 Joint Publications Research Service, Washington, D.C.
THE MECHANIZATION AND AUTOMATION OF METALLURGICAL PRODUCTION
8 Sep. 1964 11 p Transl. into ENGLISH from Metallurg (Moscow), no. 6, 1964 p 3
(JPRS-26280; TT-64-41539) OTS: $1.00

Presented are several papers describing how various metallurgical institutes are solving problems arising from the use of mechanization and automation in ferrous metallurgy. P.V.E.

N64-28417 European Atomic Energy Community, Brussels (Belgium)
POSSIBILITIES OF PREPARATION OF DISPERSION-STRENGTHENED ALUMINUM [CONTRIBUTION A L'ETUDE DES POSSIBILITIES DE FABRICATION DE PRODUITS EN ALUMINUM FRITTE]
E. G. Hess (Joint Nucl. Res. Center, Ispra Estab., Italy) Presented at Journees Met. d'automne, Paris, 14–18 Oct. 1963 in FRENCH; ENGLISH summary
(EUR-1844.f) Available from Belg. Am. Bank and Trust Co., N.Y., account no. 22.186: 50 Belg. Fr.

Some aspects regarding extrusion and several methods of cold work of dispersion-strengthened aluminum (SAP) containing 4% to 14% Al_2O_3 have been investigated. Extrusibility, extrusion constants, and the general hot-work behavior are described. Subsequent cold work carried out by rolling, drawing, tube-reducing and swaging gives a survey on some plastical attitudes. The maximum deformability—limited by the resistance to recrystallization—and the influence of cold work both on the dispersion structure and on the mechanical properties is examined. With increasing cold work three ranges with different deformation mechanisms can be observed: work hardening of the matrix, refinement of the banded structure originating from the extrusion, and considerable dispersion improvement by cracking and distribution of oxyd-agglomerates and intermetallic compounds like $FeAl_3$ in the range of the highest reductions. Author

N64-28427 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 109. MANUFACTURE OF BrAZhN 10-4-4 BRONZE CAST PARTS
9 Sep. 1964 13 p Transl. into ENGLISH from Shanghai Chih-Sieh (Shanghai), No. 3, Mar. 1964 p 13–16
(JPRS-26322; TT-64-41581) OTS: $1.00

Bronze with a composition of 10% aluminum, 4% iron, 4% nickel, and the rest of copper is called BrAZhN 10-4-4 bronze. Smelting procedures are described, pouring steps and techniques are listed, and techniques of casting into shape are discussed in detail. Heat treatment of the castings is discussed, with regard to potential advantages and conditions. Favorable properties of the bronze are summarized, and some possible applications are mentioned. D.E.W.

N64-28444 Joint Publications Research Service, Washington, D.C.
PRODUCTION PROPERTIES OF AN ALUMINUM OXIDE-COPPER ALLOY
Yu. N. Semenov, G. S. Shmakov, and L. A. Yablokova 20 Aug. 1964 10 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), v. 1, no. 3, 1961
(JPRS-26000; TT-64-41271) OTS: $1.00

Some properties of a copper-aluminum oxide alloy, produced by powder metallurgy, were investigated. Rods were made of the alloy, and various tests and analyses were conducted on the rods. It was found that the finely dispersed aluminum oxide strengthened the copper and increased its electrical resistance. An X-ray analysis confirmed that the presence of highly dispersed aluminum oxide suppressed the recrystallization process and microstructure investigations showed that the oxide in the copper was in a highly dispersed state and uniformly distributed. It is indicated that this alloy would be a practical material for electrodes that are used in spot welding. I.v.L.

N64-28445 Joint Publications Research Service, Washington, D.C.
CORROSION AND IRRADIATION
V. V. Gerasimov, A. I. Gromova, Ye. S. Golovina, G. S. Moskvichev, and F. S. Pavlova et al 20 Aug. 1964 279 p refs Transl. into ENGLISH of the book "Korroziya i Oblucheniye" Moscow, Gosatomizdat, 1963 p 1–270
(JPRS-26020; TT-64-41290)

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N64-28453 Bureau of Mines, Boulder City, Nev. Metallurgy Res. Lab.
ELECTROREFINING OF COLUMBIUM
R. E. Cumings and F. R. Cattoir [1964] 16 p refs
(BM-RI-6506)

Columbium metal was electrorefined in a fused-salt electrolyte. Excellent results were obtained in lowering the impurity content in a 94% columbium anode feed material to produce a 99.8%-pure metal. The reductions of the major impurities follow: Oxygen from 19,800 to 500 ppm, carbon from 9,700 to 25 ppm, iron from 9,200 to 630 ppm, nitrogen from 2,100 to 90 ppm, and silicon from 750 ppm to not detected. Columbium with a purity of 99.9% was produced from 99.5% and 99.8% grades of columbium. The investigation was devoted to the evaluation of a fused-fluoride-salt electrolyte ($KF-NaF-K_2$ CbF_7) for electrorefining columbium. The effects of the columbium concentration and the voltage upon the product's purity were investigated. The effect on the cathode current efficiency of amp-hr of deposition and the formation of a dual valence state of the columbium was also investigated. Author

N64-28459 Michigan U., Ann Arbor Coll. of Engineering
SINTERING OF METAL OXIDES Final Report
G.Parravano Oct. 1963 24 p refs
(Contract AF 49(638)-493)
(Rept.-02832-16-1; AD-602529)

The results on the sintering mechanism deduced from the experimental observations of the following metal oxides are summarized: AnO, TiO_2, V_2O_5, and in a qualitative fashion, NiO. The results of theoretical studies on the changes in configuration of solids by diffusion mechanisms, and the sintering of surface steps by migration are included. Progress is reported in studies of the sintering of germanium and organic compounds, and of sintering under reactive atmosphere. R.T.K.

N64-28460* Beryllium Corp., Reading, Pa.
CASTING OF BERYLLIUM–STAINLESS STEEL AND BERYLLIUM–COLUMBIUM IMPACT TARGET COMPOSITES Summary Report
C. J. Patenaude and W. H. Santschi 9 Jun. 1964 35 p refs
(Contract NAS3-3729)
(NASA-CR-54144) OTS: $3.60ph

The objective of the work was to produce tubular composites of cast beryllium–stainless steel and cast beryllium–columbium to serve as impact targets in tests of berryllium's resistance to simulated meteoroid collisions. Four basic approaches were undertaken to produce these composites, all aimed at achieving a metallurgical bond at the Be-SS and Be-Cb interfaces: (1) direct casting of the berryllium around stainless steel and columbium tubing; (2) coextrusion of cast beryllium and stainless steel; (3) silver brazing of cast beryllium to stainless steel; and (4) solid-state diffusion bonding of cast berryllium to stainless steel. Experimental techniques employed and the results of metallographic and radiographic evaluations are presented. A compilation of the targets produced is also included. Author

N64-28506 Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
ALUMINUM CORROSION IN SUBCRITICAL AND ZERO POWER CRITICAL REACTORS
Mack E. Bergstresser Jul. 1964 13 p refs
(Contract AT(07-2)-1)
(DP-911)

Natural uranium aluminum-clad fuel slugs are subject to corrosion in low-temperature (< 100° C) water during service in subcritical and zero-power nuclear reactors. This report discusses pitting corrosion and galvanic corrosion of aluminum in such service. The use of high-purity water or the addition of chromates as inhibitors will minimize the corrosion rates. Author

N64-28514 Joint Publications Research Service, Washington, D.C.
COLLOQUIUM ON BRAZING OF METALS AT THE XVI CONGRESS IN HELSINKI 1963
Ye. K. Alekseyev 19 Aug. 1964 6 p Transl. into ENGLISH from Svarochnoye Proizvdstvo (Moscow), No. 6, 1963 p 42–43
(JPRS-25954; TT-64-41225) OTS: $1.00

Fourteen reports and communications from various countries are presented at the colloquium on research of brazing joining, new brazing techniques, and design peculiarities of brazing joining. Data are furnished in reports on brazing carbon steel by using oxygen-acetylene flame. The composition of brazing alloys was brass (58% to 60% Cu; 40% to 42% Zn:Si); copper–nickel alloy (45% to 47% Cu; 43% to 45% Zn; 10% Ni, Si); silver alloy (40% Ag; 19% Cu; 21% Zn; and 20% Cd) Research was also carried out on influence on the strength of brazed joints by a degree of surface cleaning in preparation for brazing, the dimensions, and the mechanical properties of the basic metal. Author

N64-28571 Massachusetts Inst. of Tech., Cambridge
SUBSTRUCTURE AND MECHANICAL PROPERTIES OF REFRACTORY METAL WIRES Technical Documentary Report, 1 Apr.–30 Oct. 1963
Roy Kaplow, John F. Peck, Frank T. J. Smith, and David A. Thomas Wright-Patterson AFB, Ohio, AF Mater Lab. May 1964 53 p refs
(Contract AF 33(657)-11238)
(ML-TDR-64-56; AD-602695)

Polycrystalline columbium wires of three levels of interstitial impurity content show steady work hardening in wire drawing to the highest strain obtained, a true strain of 5.1. This behavior contrasts to fcc metals, which show saturation of work hardening at true strains greater than 2. During drawing of random-texture columbium, a fibrous microstructure and the [110] wire texture continually develop. If the material has an initial [110] texture, however, the texture diminishes because of deformation band formation, and subsequent recrystallization produces near-random orientation. Swaged wire also shows continued work hardening and develops a cylindrical texture at high strains. Torsion stress–strain curves for both polycrystalline and single crystal columbium have been obtained, and the effect of strain reversal was studied. A region of work softening was observed in both as-drawn wire and single crystals after reversal of comparable forward strains in drawn wire annealed at 700° C or above prior to testing. Author

N64-28583 Dynatech Corp., Cambridge Mass.
STUDY OF OXIDES FOR O_2–N_2 SEPARATION Sixth Quarterly Progress Report, 15 Apr.–15 Jul. 1964
30 Jul. 1964 44 p
(Contract AF 33(657)-10797)
(Rept.-488; AD-603338)

The work performed included these: (1) studies of the morphology of microporous particles; (2) a study of sintering of cobalt oxide powders; and (3) the development of test procedures for the determination of particle structures. R.T.K.

N64-28611 Metals and Controls, Inc., Attleboro, Mass.
STUDY OF DUCTILE COATINGS FOR THE OXIDATION PROTECTION OF COLUMBIUM AND MOLYBDENUM ALLOYS Bimonthly Progress Report, 1 Mar.–30 Apr. 1964
31 May 1964 33 p refs
(Contract NOw-63-0706-c)
(BPR-5; AD-601740)

Airflow vs weight loss rate data on pure platinum were extended to an airflow rate of 960 ipm at 2,550° F. Increases in flow rate have a diminishing effect on weight loss rates at higher and higher flow rates. Diffusion studies were performed on platinum-2.5% palladium alloy clad FS-85 and TZM at 2,550° F. The diffusion appeared to be transgranular and very rapid for both the TZM and the FS-85 base samples. Layers of gold, rhenium, aluminum, and boron nitride were deposited on refractory base metal for diffusion barrier studies. Evaluations of the samples containing aluminum and boron nitride indicated that these materials are not useful for diffusion barriers. Author

N64-28624 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
THE HAFNIUM-TANTALUM EQUILIBRIUM DIAGRAM
Laurance L. Oden, D. K. Deardoff, M. I. Copeland, and H. Kato 1964 16 p refs
(BM-RI-6521)

Alloys were prepared from high-purity components by nonconsumable-tungsten-electrode arc melting. Data for the equilibrium diagram were obtained by optical pyrometry, metallography, X-ray diffraction of heat treated specimens, X-ray diffraction using a high-temperature camera, and differential thermal analysis. The bcc allotrope of hafnium forms a continuous series of solid solutions, called beta, with tantalum that exhibit a minimum melting point at 20 wt % tantalum and 2,110° C. At 24 wt % tantalum and 1,050° C, hafnium-rich beta decomposes in a monotectoid reaction to yield alpha and tantalum-rich beta. The monotectoid isotherm extends from 5.5 to 60 wt % tantalum. The two-phase region, in which hafnium-rich and tantalum-rich beta solid solutions are immiscible, rises to a maximum temperature of 1,265° C at 38 wt % tantalum. The solubility of hafnium in tantalum decreases from 40 wt % at the monotectoid temperature to 20 wt % at 750° C. Author

N64-28628 Army Engineer Research and Development Labs., Fort Belvoir, Va.
LONG-TERM RUPTURE STRENGTH OF ALLOYS AND PLASTICS FROM TENSILE STRENGTH AT ELEVATED TEMPERATURES
S. Goldfein 28 Apr. 1964 31 p refs
(TR-1773; AD-602203) OTS: $1.00

This report covers an investigation to determine if the long-term tensile stress-rupture strength of alloys could be calculated from the results of static tensile strength tests at elevated temperatures. Twenty-one alloys were investigated. A second-order form of a mechanical–chemical equation of state was used to draw master rupture curves from both long-term rupture and tensile strength data. It is concluded that the long-term strength of an alloy can be computed from a knowledge of its tensile strength at elevated temperature, chemical composition, and mode of failure. Author

N64-28675 Bureau of Mines, Berkeley, Calif. Thermodynamics Lab.
LOW-TEMPERATURE HEAT CAPACITIES AND ENTROPIES AT 298.15° K OF SULFIDES OF ARSENIC, GERMANIUM, AND NICKEL
William W. Weller and K. K. Kelley 1964 11 p refs
(BM-RI-6511)

This report contains experimentally determined heat capacity data for four crystalline sulfides—AsS, GeS, NiS, and Ni_3S_2—over the temperature range from 50° to 298.15° K. The heat capacity data were used to evaluate the entropies of the sulfides at 298.15° K. Entropies of formation from the metals and rhombic sulfur and from the metals and diatomic sulfur gas are also included. Author

N64-28693 Aluminum Co. of America, New Kensington, Pa.
NOTCH SENSITIVITY OF ALUMINUM-ZINC-MAGNESIUM ALLOYS AT CRYOGENIC TEMPERATURES
W. A. Anderson, J. G. Kaufman, and J. E. Kane Repr. from Advan. Cryog. Eng., v. 9, 1964 p 104–111 refs Presented at Cryog. Eng. Conf., Boulder, Colo., 19–21 Aug. 1963

The following conclusions appear warranted concerning the relative notch sensitivities of alloys X7002, X7005, X7006, X7039, and X7106 at room temperature and cryogenic temperatures: (1) At room temperature, all of the alloys are relatively insensitive to notches, as indicated by relatively high ratios (notch-yield ratios above 1.06), and ratios that are nearly the same for all compositions in-T6-type tempers. (2) Alloys X7006-W, X7005-T6, X7006-T63, and X7106 in the -T6 and -T63 tempers are relatively insensitive to notches over the entire temperature range from room temperature to −423° F. (3) The notch toughness of X7002-T6, X7006-T6, and X7039-T6 decreases with decreasing temperature, but even at −423° F, the notch yield ratios of the latter two alloys are equal to or greater than about 0.8. (4) The notch toughness of aluminum alloys is generally related to the level of yield strength; with increase in yield strength, notch toughness, as indicated by notch yield ratio, decreases. (5) Alloy X7106, regardless of temper (-T6 or -T63), provides an appreciably higher level of notch toughness for a given level of yield strength than the other 7000-series alloys at cryogenic temperatures. (6) The relative ratings of aluminum alloys with regard to notch sensitivity are independent of the notch tip radius within the range associated with theoretical stress concentrations from 7 to 17. Author

N64-28695 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
THE CHROMIUM–GADOLINIUM SYSTEM
M. I. Copeland, C. E. Armantrout, and H. Kato 1964 13 p refs
(BM-RI-6503)

The data collected during this investigation indicate that the chromium–gadolinium system has extensive liquid immiscibility and one eutectic point. Liquid immiscibility occurred at temperatures above the monotectic isotherm, 1,830° C, which extended from less than 0.25 to about 85 wt% gadolinium. The eutectic was at 96% gadolinium and 1,170° C. Gadolinium and chromium were the only phases in this system. There was a solid solubility of less than 0.25% gadolinium in chromium at 1,730° C and less than 0.10% chromium in gadolinium at 1,160° C. The alloys were prepared by nonconsumable-electrode arc-melting, and the alloy system was investigated by heat treatment, metallography, thermal analysis, and X-ray diffraction. All the melting, heat treatments, and thermal analyses were conducted in a vacuum or in helium because of the reactivity of chromium and gadolinium with the components present in the atmosphere at elevated temperatures. Author

N64-28734 Joint Publications Research Service, Washington, D.C.
SOVIET CONFERENCES ON METALLURGY
M. M. Popekhin et al 20 May 1964 72 p refs Transl. into ENGLISH from Russian Periodicals
(JPRS-24651; OTS-64-31281) OTS: $1.75

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N64-28777 Joint Publications Research Service, Washington, D.C.

DEFORMATION AND DESTRUCTION OF ROLLED BERYLLIUM OF DIFFERENT PURITY

V.M. Amonenko, V. M. Azhazha, V. Ye. Ivanov, G. F. Tikhinskiy, and V. A. Finkel' 8 Sep. 1964 12 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 16, no. 6, May 1964 p 426–432

(JPRS-26301; TT-64-41560) OTS: $1.00

Investigations were made of plastic flow and character of destruction at temperatures of 20° C—800° C of beryllium strips of 99.0% and 99.6% purity, obtained by rolling castings in vacuum. It was determined that basic mechanism of plastic flow is slip in system $(10\bar{1}0)$ $[11\bar{2}0]$; destruction occurs on planes of cleavage at low temperatures or on boudaries of grains at high temperatures. Impurities exert a substantial influence on magnitude of plastic flow and character of destruction. Yield point of beryllium of high purity in investigated region of temperatures is a few times lower than yield limit of metal of 99.0% purity. Metal of technical purity essentially constitutes a strengthened alloy. Author

N64-28778 California U., Livermore Lawrence Radiation Lab.

THE PROPERTIES OF A METASTABLE GAMMA-PHASE URANIUM-BASE ALLOY: U-7.5 Nb-2.5 Zr

C.A.W. Peterson and R. R. Vandervoort 13 May 1964 38 p refs

(Contract W-7405-ENG-48)

(UCRL-7869) OTS: $0.75

The uranium-niobium-zirconium ternary system exhibits a series of solid solutions at high temperature. Addition of both niobium and zirconium stabilizes the body-centered-cubic gamma phase to a lower temperature. A study has been made of one particular ternary alloy, the U-7.5 w/o Nb-2.5 w/o Zr composition. The relationship of transformation characteristics of the alloy to its physical and mechanical properties was determined. This weldable alloy is concluded to be an excellent material for engineering applications. Tensile yield strengths of 100,000 to 200,000 psi are obtainable, with elongations of 12% to 4%, respectively, depending on heat treatment. Author

N64-28785 Battelle Memorial Inst., Columbus, Ohio

CONSTITUTION OF THE SYSTEMS OF URANIUM AND CARBON WITH MOLYBDENUM, NIOBIUM, RHENIUM, TUNGSTEN, AND YTTRIUM

Walston Chubb and Donald L. Keller 11 Aug. 1964 43 p refs (Contract W-7405-eng-92)

(BMI-1685) OTS: $1.00

The uranium-carbon-molybdenum system was found to contain only one ternary phase, $UMoC_2$, possessing a range of homogeneity from 46 to 50 a/o carbon. A pseudo-binary tie line exists between UC and molybdenum below 1,800° C. Between 1,800° and 1,900° C, UC and molybdenum react peritectically to form uranium liquid and $UMoC_2$. Pseudo-binary systems also exist between $UMoC_2$ and UC, graphite, Mo_2C, and molybdenum. Nb_2C and NbC in intimate contact with liquid uranium at 1,540 C contained less than 1 a/o uranium; the uranium contained no detectable niobium. The UC-NbC solid solution does not contain less than 49 a/o carbon at any composition containing more than 1 a/o uranium. The NbC corner of the NbC-Nb_2C-uranium region lies near 45 a/o carbon, 54 a/o niobium, and less than 1 a/o uranium. The uranium-carbon-rhenium system contains a ternary phase, URe_2C_2. Pseudo-binary tie lines extend from UC to URe_2, from UC to rhenium, and from URe_2C_2 to rhenium. Like in the uranium-carbon-molybdenum system, pseudo-binary tie lines exist in the uranium-carbon-tungsten system at 1,500° C between UC and tungsten and between UWC_2 and all the phases in the system except uranium. Author

N64-28811 Battersea Coll. of Tech. (Gt. Brit.)

USE OF REACTIVE ATMOSPHERES FOR THE TREATMENT OF B.C.C. METALS Quarterly Engineering Progress Report No. 6, 1 Jan.–31 Mar. 1964

I. J. Toth [1964] 5 p

(Contract N62558-3591)

(AD-440990)

Densities of the compacts sintered in the presence of bromine are slightly but consistently higher than those of compacts sintered in hydrogen for equivalent times. Bromine has a more marked effect on bending strength increasing it for all treatment times. Tests on tungsten compacts sintered after impregnation with nickel showed that fracture is intercrystalline and that the removal of the nickel from the specimen by soaking in molten copper increases the bending strength. A.W.

N64-28813 Alloyd General Corp., Cambridge, Mass.

EFFECT OF FLUID ENVIRONMENT ON TORSIONAL FATIGUE FAILURE Progress Report No. 1

M. J. Hordon and P. F. Weihrauch 16 Jun. 1964 40 p refs (Contract NOw 64-0248-f)

(TR-64-GRX-10; AD-602299) OTS: $1.25

A study of the interaction of the relevant parameters leading to fatigue failure under conditions of torsional loading was initiated. An experimental program aimed at studying the effects of strain amplitude, microstructure, lubricant chemistry, and lubricant viscosity on the initiation of fatigue cracks and their subsequent growth to failure was developed. Experimental techniques were developed to monitor both the surface and internal damage accompanying the fatigue process, as well as the changes in work-hardening behavior during fatigue. The results of testing bearing grade 52100 steel in two fluid environments are presented. Author

N64-28814 Naval Research Lab., Washington, D.C.

HIGH TEMPERATURE PROPERTIES OF SODIUM AND POTASSIUM Progress Report No. 12, 1 Jul.–30 Sep. 1963

C. T. Ewing, J. P. Stone, J. R. Spann, E. W. Steinkuller, D. D. Williams et al 9 Jun. 1964 47 p refs

(NRL-6094; AD-602243) OTS: $1.25

An experimental program is in progress to measure various thermophysical properties of sodium, potassium, cesium, and their vapors. A complete reporting of the preliminary experimental results for potassium (saturation and superheat properties of the vapor, density, and specific heat of the liquid) is presented, together with a thermodynamic treatment of the data. Two equations of state are advanced, and additional saturation and superheat properties of the vapor are derived from these equations. Engineering properties (enthalpy, entropy, specific volume, and specific heat) and compositional information (weight fraction of dimer, weight fraction of trimer, and average molecular weight) are tabulated for some 800 selected vapor states in the temperature range from 1,400° to 2,525° F and in the pressure range from 0.2 to 28 atm. Author

N64-28829* New York U., N.Y.
EFFECT OF PRESSURE ON METALLURGICAL PHENOMENA Progress Report No. 8, Dec. 22, 1963–Jun. 30, 1964
[1964] 4 p
(Grant NsG-90-60)
(NASA-CR-58492) OTS: $1.10 ph

Studies of tranformations in the following alloy systems are reported: Tl-In, Tl-Pb, and Tl-Hg. The Tl-Pb system is being studied to provide some information on the alloying behavior of thallium as a function of temperature and pressure. Twenty-three Tl-Pb alloys covering the range from 60% to 100% Tl have been prepared, and eight of these have been processed to wire for pressure–temperature experiments. M.P.G.

N64-28844* Massachusetts Inst. of Tech., Cambridge
PARTICLE COARSENING IN A COPPER-SILICA ALLOY
Noboru Komatsu and Nicholas J. Grant Repr. from Trans. Met. Soc. AIME, v. 230, Aug. 1964 p 1090–1096 refs
(Grant NsG-117-61)

Electron-micrographic studies and hardness tests were made of an internally oxidized dispersion-strengthened Cu-12 vol pct SiO_2 alloy following longtime annealing at elevated temperatures. The rate of coarsening of SiO_2 particles and the relationship between hardness and interparticle spacing were measured. The rate of coarsening of SiO_2 particles is controlled by the decomposition of SiO^2 rather than by the diffusion rates of silicon or oxygen through the copper matrix. The mechanism of coarsening was also studied by using a diffusion-couple technique. Author

N64-28846* Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
DEVELOPMENT OF A HIGH STRENGTH ALUMINUM ALLOY, READILY WELDABLE IN PLATE THICKNESSES, AND SUITABLE FOR APPLICATIONS AT −423°F (−253°C) Progress Report 13, 1–31 Jul. 1964
R. W. Westerlund 19 Aug. 1964 24 p
(Contract NAS8-5452)
(NASA-CR-58616) OTS: $2.60 ph

Tensile and notch-tensile properties of Al-Cu-Cd and Al-Cu-Cd-Sn alloys (M825) have been determined at room temperature, −112° F, and −320° F, and arrangements have been made for testing at −423° F. The M835 welded as 0.125-in. sheet with alloy 2319, M825, and Al-Cu fillers, all containing 0.23 Cd, 0.12 Mg, or 0.53 Mg showed little variation in weld strength. The 1.0-in. plate meets the minimum strength goal, but the 2.37-in. plate falls short, probably because of quench sensitivity. Material roller leveled but not stretched had properties equivalent to preaged, stretched, and aged material, indicating the possibility of eliminating the preaging treatment. Work on other alloys indicates that deformation before aging may improve notch toughness slightly for Al-Zn-Mg alloys with no Zr. The toughness of alloys containing Zr is increased slightly by cold working before aging. Alloy M826 had strengths lower than desired, but attempts are being made to achieve higher properties by reheating. Stress corrosion testing of M825 and M826 has started. M.P.G.

N64-28854* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
REFRACTORY METALS FOR THERMAL-PROTECTION SYSTEMS
Eldon E. Mathauser Repr. from Astronautics and Aerospace Eng., v. 2, Jul. 1964 p 66–69 refs
(NASA-RP-302)

This paper reviews the status of refractory-metal sheet, its uses, and factors bearing on its use, such as availability, material properties, fabrication, and protective coatings. It is concluded that generally, good-quality refractory metals are available. Most interest appears to be directed at recently developed columbium- and tantalum-based alloys that exhibit moderate strength, relative ease of fabrication, and no embrittlement from recrystallization. Creep problems may be encountered with some alloys, particularly if higher temperatures of use are achieved through improved coating. Mechanical fastening is preferable for joining. Welding under carefully controlled conditions may be feasible for some alloys; brazing and diffusion bonding may also prove of interest for some applications. Availability of suitable protective coatings is the most important factor in determining whether refractory metals can be utilized in thermal-protection systems. Author

N64-28870 Frankford Arsenal, Philadelphia, Pa.
THE EFFECT OF TEMPERATURE ON THE PROTECTION BALLISTIC LIMIT OF ALUMINUM ALLOY ARMOR
Burr W. Collins Jul. 1963 13 p
(M64-3-1; AD-411193)

A year's ballistic test results for 1 1/4-, 1 1/2-, and 1 3/4-in. aluminum alloy armor plate were plotted and the values averaged for certain temperature increments. The plotted averages indicate that a decrease of one fps in protection ballistic limit corresponds with an increase in plate temperature before firing of 2.2° F when the projectile is 20 mm fragment simulator and 1.2° F for caliber 0.30 armor piercing projectiles. Author

N64-28887* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CORROSIVE EFFECTS OF PURE AND DISTILLED WATER
Kay Haines 16 Jan. 1964 13 p refs
(NASA-CR-58640; JPL Lit. Search-567) OTS: $1.60 ph

This contains 47 abstracts on the subject taken from books and papers, proceedings and symposia, reported in Chemical Abstracts, Corrosion Abstracts, Engineering Index, and the American Ceramic Society Journal. A.W.

N64-28983 Oak Ridge National Lab., Tenn.
CONTAMINATION OF REFRACTORY METALS BY RESIDUAL GASES IN VACUUMS BELOW 10^{-6} TORR
H. Inouye Sep. 1964 34 p
(Contract W-7405-ENG-26)
(ORNL-3674) OTS: $0.75

The contamination of niobium, molybdenum, tantalum, Nb–1% Zr, FS-85, D-43, Cb-752, TZM, and T-111 resulting from their extended exposure to the residual gases in high

vacuums was measured by chemical analyses. This contamination was characterized in terms of the system pressure, metal temperature, exposure time, metal surface-to-volume ratio, and alloy composition. A second phase of the study was concerned with developing techniques for lowering the contamination of Nb–1% Zr with refractory metal envelopes, vapor-plated molybdenum, and intentional additions of nitrogen or CH_4 to vacuum atmosphere to counteract the noxious gases. Author

N64-29005* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EFFECT OF GRAIN SIZE AND IMPURITIES ON TENSILE STRENGTH AND DUCTILITY OF TUNGSTEN FROM 2500° TO 5000° F IN VACUUM

J. L. Taylor, D. H. Boone, and O. W. Simmons 1 Jul. 1964 14 p refs

(Contract NAS7-100)

(NASA-CR-58237; JPL-TR-32-632) OTS: $1.60 ph

The effect of grain size and impurity level on the tensile strength and ductility of powder-metallurgy tungsten was determined by comparing recrystallized coarse- and fine-grained undoped tungsten with recrystallized fine-grained doped tungsten. Tests were conducted in vacuum at a strain rate of 0.02/min from 2,500° to 5,000° F. Both fine-grained materials were about the same strength, and both were stronger than the coarse-grained material. Ductility for the doped (higher impurity level) fine-grained tungsten was lower than for the undoped fine-grained tungsten in which stress-induced grain growth occurred more readily. Stress-induced grain growth correlates in a general way with ductility measured by either reduction in area or elongation. High and low values of stress-induced grain growth are associated with high and low values of ductility, respectively. In the intermediate temperature region, between approximately 50% and 65% of the absolute melting point, where a ductility minimum occurs, grain boundary sliding and its effects, i.e., void nucleation, growth, and intercrystalline fracture, appear to predominate to reduce ductility in both fine-grained materials. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-28045 Joint Publications Research Service, Washington, D.C.

RESEARCH ON THE INTERNAL CONSUMPTION OF Li_2O-K_2O-Al_2O_3-SiO_2 MICRO-CRYSTAL GLASS

Li Chia-chih, Lo Chieh-yao, and Ch'en Hui-min *In its* Transl. on Communist China's Sci. and Technol. no. 100 30 Jul. 1964 p 35–50 refs (See N64-28041 20-07) OTS: $3.00

Measurement of the internal consumption of glass is a method to investigate the retarding elasticity of glass. Because of the influence of retarding elasticity of glass on varying temperatures in prior heat processes, on the movement of ions or atoms in glass, on the change in some positive ions in the compoundings of glass, and on the crystallization process of glass, this method was recently used more and more extensively for discussion of glass structure. The peaks of internal consumption in silicate alkali glass at room temperature (low-temperature peak), between 100° and 260° C (medium-temperature peak), and near 300° C (high-temperature peak) were extensively investigated. It is generally acknowledged that the low-temperature peaks are induced by the diffusion of alkali metal ions and that the medium-temperature peaks are induced by the diffusion of nonbonding oxygen ions; the explanation for high-temperature peaks is still not definite. Research was done on the internal consumption and the electric conductivity of Li_2 O-K_2O-Al_2O_3-SiO_2 glass to discover the neutral effect of internal consumption and electric conductivity induced by mixed ions of alkali metals. This proved that the low-temperature peak is actually induced by the diffusion of alkali ion metals. An explanation for high-temperature peaks is discussed on the assumption that the glass lattice cavity defect may exist in glass. Moreover, based on experimentation, it is suggested that this peak may possibly be induced by the diffusion of silicon and oxygen atoms. Author

N64-28069 Bureau of Mines, College Park, Md.

EXAMINING AND TESTING CLAY FROM HARTFORD COUNTY, CONN., FOR LIGHTWEIGHT AGGREGATE USE. THE CLARK BRICK CO. DEPOSIT AT SOUTH WINDSOR

W. T. Millar and H. P. Hamlin 1964 26 p refs

(BM-IC-8228)

Exploration of the clay deposit supports the conclusion that the reserves of clay are sufficient for economical mining operations to produce lightweight aggregate. Preliminary tests indicated that the clay has a short bloating range. Initial expansion occurred at 2,000° F, and at 2,100° F the clay was slightly overfired and sticky. Rotary kiln tests verified the preliminary data, and these tests showed that the clay would make a good lightweight aggregate if the processing temperature and the kiln feed sizes were closely controlled. Lightweight concrete made from the processed aggregate had properties comparable to those of concrete made from a commercial clay aggregate. Author

N64-28105 Joint Publications Research Service, Washington, D.C.

FIBERGLASS BOAT BUILDING

B. A. Arkhangel'skiy and I. M. Al'shits 24 Jul. 1964 167 p refs Transl. into ENGLISH of the book "Suda iz Plastmass" Leningrad, State Publishing House of the Shipbuilding Ind., 2nd ed., 1963 p 1–160

(JPRS-25575; TT-64-31847) OTS: $3.00

Reinforced plastics are gradually replacing the traditional materials (wood, steel, light alloys) for building small boats. Fiberglass is considered because of its high mechanical strength, low weight, corrosion resistance, and the simplicity of the process by which parts are made with a minimum amount of equipment. Data on the properties of fiberglass are presented. Author

N64-28188 California Inst. of Tech., Pasadena Graduate Aeronautical Labs.

FUNDAMENTAL PROBLEMS RELATING TO THE FABRICATION OF PLASTICS FOR HIGH-TEMPERATURE APPLICATION

Paul J. Blatz and W. Hoyt Andersen (Aerojet-Gen. Corp.) *In* AGARD Combust. and Propulsion 1963 p 317–402 refs previously issued as N64-81913 (See N64-28176 20-11) Pergamon: £7

The high-temperature behavior of plastics depends on a wide variety of interrelated mechanical and thermal properties

of the plastic, as well as the condition under which heat is transferred to the plastic. Thermal properties and their relation to chemical structure are discussed, as are the formation and degradation of polymers. A table of chemical bond energies is included. In the section on mechanical properties, both response behavior and fracture criteria are discussed. Distinctions among elastic, anelastic, and plastic behavior are set forth. Plots of the temperature dependence of some anelastic properties are shown, with particular reference to polymethylmethacrylate. Author

N64-28281 Naval Air Engineering Center, Philadelphia, Pa.
THERMAL RADIATION TESTS ON MIL-P-25690 STRETCHED ACRYLIC PLASTIC Interim Report
J. H. Bowen, Jr. [1964] 3 p
(NAEC-AML-1954; AD-600750)

A 24-inch ellipsoidal carbon-arc-furnace was employed to provide a square-wave pulse with an irradiance of 15 cal/cm^2/sec. The time to reach maximum irradiance was 0.003 sec. Six 3 in. × 3 in. × 1/4 in. thick stretched acrylic specimens were used in the tests. The target area was located at the geometrical center of the specimens. A 3 in. × 3 in. × 1/16 in. thick aluminum panel, coated with a highly reflectant all-acrylic white lacquer, was employed as a reflector. Two exposures were made using the reflector panel that was positioned 0.040 in. behind the acrylic specimen. Test results indicated that MIL-P-25690 stretched canopy material conformed with current square-wave pulse thermal-radiation requirements and possessed a considerable margin of safety under these conditions. It is recommended that MIL-P-25690 material be examined using a 450-kt simulated weapon pulse where an irradiance of 25 to 30 cal/cm^2/sec occurs. It is also recommended that transparent or translucent canopy-edge-attachment constructions, which are not protected by metal, be tested since the MIL-P-25690 material would be prone to drawback in these areas. I.v.L.

N64-28290* National Bureau of Standards, Washington, D.C.
EFFECTS OF COMPOSITION AND IRRADIATION ON THE GLASS TRANSITION TEMPERATURE OF METHYL METHACRYLATE-STYRENE COPOLYMERS
M. S. Parker, V. J. Krasnansky, and B. G. Achhammer (NASA) Repr. from J. Appl. Polymer Sci., v. 8, 1964 p 1825–1838 refs Presented at the Am. Chem. Soc. 135th Meeting, Boston, 2 Apr. 1959
(NASA Order R-56)

The glass transition temperatures of polystyrene, poly (methyl methacrylate), and copolymers prepared from their respective monomers were determined by using a volume dilatometer. The glass transition temperatures of polystyrene and poly(methyl methacrylate) were found to be 82° and 104° C, respectively. The glass transition temperatures obtained for the copolymers were between the values determined for each of the homopolymers and were a monotonic function of the polymer composition. The experimental values agree with predictions in the literature based on interpolation formulae. The effects of changes in composition and radiation-induced crosslinking on the glass transition of the copolymer system are described. Author

N64-28330* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FREE-FLIGHT TEST RESULTS ON THE PERFORMANCE OF CORK AS A THERMAL PROTECTION MATERIAL
Randolph A. Graves, Jr., and Thomas E. Walton, Jr. Washington, NASA, Sep. 1964 42 p refs
(NASA-TN-D-2438) OTS: $1.00

A series of flight tests was initiated for the purpose of testing ablative cork as a lightweight thermal protection material. These flight tests were conducted aboard NASA flight vehicles in the low-heating-rate environment of the afterbody regions. The test conditions covered a range of altitudes to 482,000 ft and velocities to 17,900 ft/sec. The test results show that cork can provide adequate thermal protection for a long-time, low-heating-rate environment. Author

N64-28519 Industrial Science and Technology Agency, Tokyo (Japan) Electrotechnical Lab.
STUDY OF MOLECULAR MOTIONS IN SOLID POLYMERS BY THE DIELECTRIC MEASUREMENTS
Syogo Saito Jan. 1964 86 p refs *Its* Researches No. 648

Emphasis was placed on the dielectric behaviour of polymers in the very low frequency range. The measuring frequency range extends from 10^{-4} cps to 10^{6} cps. The temperature dependence of the dielectric relaxation process, which is attributable to the micro-Brownian motion of polar segments, was determined for several amorphous and crystalline polymers. The effects of crystallinity on the magnitude of the dielectric dispersion, the relaxation time, and the distribution of the relaxation times were investigated. Special attention was paid to the dielectric behavior of polyethylene terephthalate. Detailed dielectric properties of polymers in the glass transition-temperature range were determined by very low frequency measurements. An anomalous dielectric behavior was found for several polymers. This behavior ("dielectric transition") was found to be a transition in the equilibrium state of the polymer. The temperature dependence of the dielectric relaxation process, which is attributable to the movement of side chains or to local movement of frozen main chains, was determined. I.v.L.

N64-28627 Army Corps of Engineers, Cincinnati, Ohio Ohio River Div. Labs.
REPETITIVE LOADING MODEL TESTS OF PRESTRESSED RIGID PAVEMENT ON A LOW STRENGTH SUBGRADE
Paul F. Carlton and Ruth M. Behrmann May 1964 116 p refs
(TR-4-28; AD-601883)

This report presents the results of a laboratory model study to observe the behavior of prestressed concrete slabs supported on a low-strength subgrade and tested to complete failure by repetitive loading. The purpose of the study was to develop relationships between magnitude of load, number of load applications, and pavement physical properties. Included in this report are a description of the design of the model, physical properties of the materials comprising the model, and test procedures and instrumentation used with the model. The test results are presented with an analysis and discussion. Author

N64-28643 Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Sciences Lab.
EVALUATION OF OPTICAL PROPERTIES AND ENVIRONMENTAL STABILITY OF SOLAR CELL ADHESIVES
R. E. Mauri Apr. 1964 22 p
(LMSC-AO-34229)

All of the adhesives withstood thermal cycling, heat, cold soak, and humidity exposure in accordance with specified test conditions, without changes in visual appearance, measured optical properties, or in the mechanical integrity of bonded test specimens. The adhesive having the highest ultraviolet stability was XR63488 (Sylgard 182). There was no measurable loss of optical transmittance of test specimens prepared with this adhesive (used without primer) and the OCL 207

filter coated slides even when subjected to the maximum ultraviolet test exposure of 2,000 sun-hours (10-sun intensity for 200 hours). The same adhesive, tested with primer-coated slides, had an average decrease of transmittance, measured over the entire 500 to 900 mμ wavelength range, of 1.2% after the same exposure. Author

N64-28752* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AMORPHOUS PHOSPHATE COATINGS FOR THERMAL CONTROL OF ECHO II
Dewey L. Clemmons, Jr. and John D. Camp Repr. from Electrochem. Technol., v. 2, no. 7–8, Jul.–Aug. 1964 p 221–232 refs previously published as N64-12597 08-33
(NASA-RP-303)

The absorptance and emittance characteristics of some amorphous phosphate coatings applied to an aluminum-foil substrate have been investigated to determine their usefulness as thermal control coatings for the Echo II satellite. The spectral absorptance was measured over the range 0.22μ to 15μ, and the total hemispherical emittance was determined for specimen temperatures in the range 0° to 100° C for coating surface densities up to 400 mg/ft^2. The equilibrium temperature control parameter, α_s/ϵ, varies over the range 7.5 to 0.82 for the surface densities investigated. The thermal radiation stability of the coating is presented for periods up to 1,250 hr in a simulated space environment. Author

N64-28871 Naval Radiological Defense Lab., San Francisco, Calif.
GAMMA RADIATION EFFECTS ON ISOPRENOIDS. I: SQUALENE
J. F. Pestaner and R. Y. Yahiku 29 Oct. 1963 14 p refs
(USNRDL-TR-671; AD-420985)

Squalene, a liquid hexamer having the fundamental isoprenoid molecular structure of natural rubber, was irradiated with cobalt-60 gamma rays. The squalene was radiolyzed in vacuum, and the dose absorption varied from 0.13 to 2.1 megarad. Gas chromatographic product analysis showed that hydrogen and methane are produced in the greatest amounts. The values obtained were in units of G (molecules per 100 ev of energy absorbed) where $G(H_2) = 0.58 \pm 0.02$ and $G(CH_4) = 0.018 \pm 0.001$. The yields of 10 other low-molecular-weight products were measured with a total $G < 0.003$. A relationship of hydrogen yield from the radiolysis of squalene and other simple isoprenoid structures to that of rubber was demonstrated. Author

N64-28873 Naval Research Lab., Washington, D.C. Mechanics Div.
A COMPARISON OF STATIC AND DYNAMIC PROPERTIES OF PHOTOELASTIC MATERIALS
A. B. J. Clark and R. J. Sanford 29 May 1963 10 p refs
(NRL-5940; AD-407316) OTS: $0.50

The dynamic values of the modulus of elasticity and photoelastic fringe constant of Homalite 100 and 10 epoxy resins were determined. Of these 11 materials, five exhibited desirable dynamic properties including two materials that exhibited no appreciable change in fringe constant. Consequently a static calibration on these materials can be used for dynamic experiments with a high degree of accuracy. Included in this group of five materials were three materials that can be purchased in precast shapes, thus enabling laboratories without casting facilities to obtain suitable materials for dynamic photoelastic experiments. Author

N64-28895* Stanford Research Inst., Menlo Park, Calif.
A STUDY OF BONDING BETWEEN GLASS AND PLASTIC IN GLASS-REINFORCED PLASTICS: PHASE I Fourth Summary Technical Report, Jun. 1, 1963–Jul. 31, 1964
D. L. Chamberlain, Jr. 31 Jul. 1964 25 p refs
(Contract NASr-49(14))
(NASA-CR-58695) OTS: $2.60 ph

Samples of a variety of silicas and one sample of soft glass have been chlorinated with phosgene. The silicas have been fluorinated with elemental fluorine. For both halogens, the yield of halogen atoms per unit surface area approaches the calculated value for the number of silicon atoms per unit surface area of crystalline quartz. The yield of halogen atoms per unit surface area also agrees well with the experimentally determined number of silanol groups per unit surface area of commercial silica gels. The reactions of silica and glass with phosgene and with fluorine are clean, straightforward, easily run, and reproducible. Low temperature (ca. 400° to 500° C) chlorination of silica with phosgene appears to cause replacement of surface-bound OH groups. Fluorination, or higher temperature chlorination, is accompanied by cleavage of Si-O-Si bonds in the bulk of the silica, with subsequent erosion of the surface. Author

N64-28995* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMAL EXPANSION OF YTTRIUM OXIDE AND OF MAGNESIUM OXIDE WITH YTTRIUM OXIDE
T. H. Nielsen and M. H. Leipold Repr. from J. Am. Ceram. Soc., v. 47, no. 5, May 1964 2 p refs
(Contract NAS7-100)
(NASA-CR-58310; JPL-TR-32-651)

The thermal expansion of polycrystalline yttrium oxide and of magnesium oxide plus 3 wt % yttrium oxide was measured in both high-oxygen and argon–hydrogen atmospheres to above 2,000° C. The results of the tests on Y_2O_3 indicated no significant difference in the values of the expansion in the two test atmospheres. Permanent expansion of the specimens occurred in both test atmospheres above 2,000° C. The specimen tested in the argon–hydrogen atmosphere lost 0.3% weight. The results of the tests on MgO plus 3 wt % also showed no significant difference in the values of expansion in the two test atmospheres. The specimens sintered during the tests, and the expansion values were corrected from the shrinkage that occurred. These specimens had good chemical stability in all tests, although a second phase was observed at the grain boundaries. M.P.G.

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-27911* Geophysics Corp. of America, Bedford, Mass.
MOMENT METHOD FOR SOLUTION OF THE SCHWARZSCHILD-MILNE INTEGRAL EQUATION Scientific Report No. 1
Jean I. F. King and E. T. Florance Jul. 1963 22 p refs
(Contract NAS5-3352)
(NASA-CR-60001; GCA-TR-63-24-N) OTS: $2.60 ph

The underlying basis of the extreme accuracy of the double-gauss quadrature formula devised in the method of discrete ordinates is uncovered in an alternative solution of the transfer equation. The Schwarzschild–Milne integral equation is solved by approximating the exponential integral kernel with a finite sum of exponential functions. A moment method is used to provide the best fit to the kernel. The constants that result are identical to those following from the choice of a double-gauss quadrature formula in the discrete ordinate method. The integral equation formalism is then applied to the nongray atmosphere problem. Author

N64-28055 Illinois U., Urbana Coordinated Science Lab.
TIME OPTIMAL CONTROL OF NON-LINEAR SAMPLED-DATA SYSTEMS
Soe M. Win May 1964 72 p refs
(Contract DA-28-043-AMC-00073(E))
(R-210; AD-601622)

Procedures for the investigation of controllability, attainability, and reachability of sampled-data systems with saturation constraints are presented. Necessary and sufficient conditions for complete controllability, attainability, and reachability of single-input, time-invariant, sampled-data systems with saturation constraints are given. Conditional controllability, attainability, and reachability are introduced, and sufficient conditions are derived. Complete controllability and attainability of time-varying systems are investigated also. Simple sufficient conditions are derived when the system matrices are either asymptotic to constant matrices or periodic. Procedures for the formulation of optimal strategies are discussed. The optimal strategy used in this thesis involves forcing the system to the boundary surface first, and then to the desired state. The above procedure is not only simple, but also applicable to both time-invariant and time-varying sampled-data systems of arbitrary order. Several examples are worked out to illustrate the procedures for obtaining optimal strategies and the procedures for the investigation of controllability, attainability, and reachability of sampled-data systems with saturation constraints. Author

N64-28079* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NOTES ON VON ZEIPEL'S METHOD
Giorgio E. O. Giacaglia Jun. 1964 27 p refs
(NASA-TM-X-55058; X-547-64-161) OTS: $2.60 ph

Since the rediscovery of von Zeipel's method and its successful application to the problem of artificial satellites, many other problems have been solved by the same method, thus proving its great applicability. This paper presents the general equations of von Zeipel's method and briefly discusses their applicability. Author

N64-28091 European Atomic Energy Community, Brussels (Belgium)
EFFICIENT REALIZATION OF BOOLEAN FUNCTIONS BY MEANS OF DIODE CONJUNCTION MATRICES AND MINIMAL COST ASSEMBLING PROBLEMS
P. Camion and L. Verbeek Joint Nucl. Res. Center, Ispra Estab. (Italy) Jul. 1964 11 p
(EUR-600.e,f) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 40 Belg. Fr.

The realization of the second Boolean functions of n binary variables given together with their negation by means of diode conjunction matrices is investigated. The different possible schemes of realization are compared in terms of the number of diodes involved. It is proved that partitioning of the n variables in two equal (if n is even) or almost equal (if n is odd) sets and continued partitioning of these sets according to the same rule until the sets obtained contain less than four variables results in the scheme involving the least number of diodes. This minimal number of diodes is given for n from 1 up to 20. A general assembling problem is formalized in terms of schemes, following this particular example. This formalization leads to a solution recurrent on the number of inputs of a scheme. It is shown how a minimal cost disassembly problem can be treated in the same way. In this problem the cost function is such that the solution is not given by a foreseeable law. Author

N64-28109 California U., Livermore Lawrence Radiation Lab.
TABLES OF CALABRO KAPPA SQUARE STATISTIC
James L. Willows 11 Jun. 1964 65 p refs
(Contract W-7405-ENG-48)
(UCRL-7920) OTS: $1.50

The tables in this report present values of the K^2 statistic developed by S. R. Calabro: $K^2 = [Z_\alpha - Z_\beta\sqrt{k/k-1}]^2$, where Z_α is the normal deviate corresponding to the producer's risk, R_α; Z_β is the normal deviate corresponding to the consumer's risk, R_β; and k is the lot tolerance fractional reliability deviation divided by the acceptable reliability level. This statistic is useful in calculating test time for a given reliability and confidence level. G.D.B.

N64-28126 European Atomic Energy Community, Brussels (Belgium)
TOTALLY UNIMODULAR MATRICES AND COMBINATORIAL PROBLEMS [MATRICES TOTALEMENT UNIMODULAIRES ET PROBLEMS COMBINATOIRES]
P. Camion Joint Nucl. Res. Center, Ispra Estab. (Italy), May 1964 87 p refs in FRENCH; ENGLISH summary
(EUR-1632.f) Available from Belg. Am. Bank and Trust Co., N.Y., account no. 22.186: 125 Belg. Fr.

In the theory of linear economical models, numerous problems have as models linear programs where solutions in integers are required. Shown are that two subclasses of E-matrices defined by A. J. Hoffman belong to the class of cyclomatic matrices. A class of matrices defined by Tutte coincides with the class of linear transforms of E-matrices. The E-matrices are characterized by utilizing concepts of the theory of graphs and the homomorphisms of the ring of integers on the quotient field modulo 2. In particular the known fact that the cyclomatic and cocyclomatic matrices of graphs are E-matrices results immediately from this characterization. A criterion is given in order that the polyhedron $\{x \mid Ax = 0;\ a \leq x \leq b;\ [x_i]_{mod_1} = 0\}$ (a and b, vectors with integer coordinates, A being an E-matrix) be nonempty. This criterion is given by a more general theorem on Abelian groups. This theorem generalizes the theorem of A. J. Hoffman on the existence of a flow in a network and another theorem by the same author given as the most general of the Hall type. Various theorems on flows and tensions, cycles and cocycles of a graph are generalized by this theorem. A characterization of cyclomatic and cocylomatic matrices of a graph that completes the one of W. T. Tutte for the homomorphisms modulo 2 of these matrices is given. A characterization of the E-matrices modulo 2 is also given. Author

N64-28137 Joint Publications Research Service, Washington, D.C.
ESSENTIAL CONDITIONS FOR OPTIMAL CONTROL IN BANACH SPACES

Yu. V. Yegorov 27 Aug. 1964 35 p refs Transl. into ENGLISH from Mat. Sb. (Moscow), v. 64, no. 1, May 1964 p 79–101
(JPRS-26168; TT-64-41427) OTS: $2.00

Several general problems of the calculus of variations, connected with the selection of optimum control, are examined. It is assumed that the condition of a controlled process in each moment of time is a point of Banach space. Author

N64-28138 Aberdeen Proving Ground, Md. Ballistic Research Labs.

THE ADDITIONAL THEOREM FOR A DERIVATIVE OF A LEGENDRE POLYNOMIAL

Boris Garfinkel May 1964 16 p refs
(BRL-1248; AD-444778)

An expression is derived for the coefficient $b_k^{n,m}$ of the Fourier expansion, $P^{(m)}(\cos\gamma) = \sum_k b_k^{n,m} \cos k\phi$, where $\cos\gamma \equiv \cos\theta_1 \cos\theta_2 + \sin\theta_1 \sin\theta_2 \cos\phi$. The expression, involving only a single summation, is useful in the potential theory and in the celestial mechanics of an artificial satellite. Author

N64-28145 Massachusetts Inst. of Tech., Cambridge Electronic Systems Lab.

SPECIALIZED COMPUTER EQUIPMENT FOR GENERATION AND DISPLAY OF THREE DIMENSIONAL CURVILINEAR FIGURES

Robert H. Stotz Mar. 1963 165 p refs
(Contract AF 33(600)-42859)
(ESL-TM-167; AD-406608)

Studies being conducted of computer-aided design of three-dimensional-shaped objects have shown the need for improved graphical man–computer communications, particularly faster displays. A straight-line-and-curve-drawing display system is proposed, which is capable of drawing two-dimensional, axonometric projections of curvilinear three-dimensional figures at up to 100 times the speed of present point-plotting display scopes. The system, based on digital incremental computing techniques, consists of a line generator to produce time varying x, y, and z pulse-train signals proportional to the numerical input informatiog; a rotation matrix to transform these signals into ones in the h and v coordinate axes of the scope; and accumulating registers (bidirectional counters) to hold the resultant data for the scope deflection amplifiers. The line generator is capable of producing straight lines and second-order curves of variable length. Author

N64-28174 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A COMMENT ON A CRITICAL CASE OF THE STABILITY OF A SINGULAR POINT ON A PLANE

R. E. Vinograd 22 Apr. 1964 10 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 101, no. 2, 1955 p 209–212
(FTD-MT-63-327; AD-602590)

Given a system of equations

$$dx/dt = P(x, y),\ dy/dt = Q(x, y), \qquad (1)$$

for which the coordinate origin O serves as an isolated singular point, there exists, for an example, such an R that $P^2(x, y) + Q^2(x, y) > 0$ at

$$0 < x^2 + y^2 < R^2;\ P(0, 0) = Q(0, 0) = 0. \qquad (2)$$

Functions P and Q are assumed to be twice continuously differentiable. The usual method of investigating a singular point O (i.e., trivial solution $x = y = 0$) for Lyapunov stability consists of the fact that at $x = y = 0$ the following equation is considered

$$\begin{vmatrix} P'_x(x, y) - \lambda & P'_y(x, y) \\ Q'_x(x, y) & Q'_y(x, y) - \lambda \end{vmatrix} = 0. \qquad (3)$$

and also the signs of the real parts of its roots

$$\alpha_1^0 = \operatorname{Re}\lambda_1^0, \alpha_2^0 = \operatorname{Re}\lambda_2^0 \qquad (4)$$

Here, if α_1^0 and α_2^0 are different from zero, then the question about stability is resolved completely, and the case $\alpha_1^0 \alpha_2^0 = 0$ is called critical and requires, as a rule, difficult additional investigations. Equation (3) is now considered, not at point O but in some neighborhood of it, $U_\epsilon(O)$, whose radius $s < R$ is sufficiently small. Then values

$$\alpha_1(x, y) = \operatorname{Re}\lambda_1(x, y),\ \alpha_2(x, y) = \operatorname{Re}\lambda_2(x, y), \qquad (5)$$

will be functions of x and y, continuous on the strength of assumed continuity $P'_x(x, y)$). $P'_y(x, y)$, etc., and will convert accordingly into (4) at $x = y = 0$. Consequently, in the noncritical case, the signs of values (5) in the small neighborhood $U_\epsilon(O)$ coincide with the signs of (4); therefore, the known criteria of the behavior of a single point can be and are formulated, using the values of (5) instead of (4). I.v.L.

N64-28223 Martin Co., Denver, Colo.

PRODUCTS AND QUOTIENTS OF RANDOM VARIABLES AND THEIR APPLICATIONS

James D. Donahue Wright-Patterson AFB, Ohio, ARL, Jul. 1964 164 p refs
(Contract AF 33(615)-1023)
(ARL-64-115; AD-603667) OTS: $3.00

The general techniques for determining the distributions of products and quotients of random variables are discussed. Some exact and asymptotic results pertaining to the distributions of the products and quotients of certain random variables, which generally occur as measurement error, are also presented, together with their applications. An extensive bibliography is included. Author

N64-28271 Sandia Corp., Albuquerque, N. Mex.

AN ALGORITHM FOR THE CALCULATION OF A CLASS OF FIXED POINTS FOR SERIAL LINEAR SYSTEMS

G. J. Simmons and L. W. Rook Apr. 1964 26 p refs
(SC-R-64-190) OTS: $0.50

A serial linear system, SLS, is defined to be a sequence of linear equations drawn from a finite set, not necessarily compatible or determinate, in which only a single equation is available at any given time, and where furthermore there is no capability for storing the equations as they occur. This may appear to be a contrived set of restraints; however, such systems have arisen quite naturally in the investigation of adaptive networks, associative memories, and linear pattern recognition logic. Obviously any procedure that is to solve an SLS must do so iteratively by computations depending only on the currently available element. This paper is concerned with an algorithm that may be used to solve an SLS if a solution exists, or else to find a fixed point corresponding to a solution point for the compatible case, if the system is overdetermined or incompatible. This algorithm depends on successive orthogonal projections of the approximate solution point Q' onto the hyperplanes defined by the elements of the SLS. A cycle of these projections, in the instance where the elements of the SLS appear cyclically, is shown to be either a contractive or an identity mapping on any sequence of image points in any hyperplane. Author

N64-28296* Martin Co., Baltimore, Md. RIAS
FUNCTIONAL DIFFERENTIAL SYSTEMS AND EXTENSION OF LYAPUNOV'S METHOD
V. Lakshmikantham Repr. from J. Math. Anal. and Appl., v. 8, no. 3, Jun. 1964 p 392–405 refs
(Contracts NASr-103; DA-36-034-ORD-3514Z)

Many problems concerning the behavior of solutions of ordinary differential systems can be made to depend on scalar differential equations. Using a comparison principle of this type and the concept of Lyapunov's functions, the author has extended many results of differential systems. In this paper, he extends analogous results to a class of general functional differential equations. The formulation of the functional-differential equation is given along with existence and uniqueness theorems. Assuming the existence of solutions, the author considers results on stability and boundedness corresponding to his own results. Examples are given to illustrate the results obtained. This work also constitutes an extension of the work by Krasovskii, Razumikhin, and Driver. I.v.L.

N64-28429 Joint Publications Research Service, Washington, D.C.
SUFFICIENT CONDITIONS FOR DERIVING AND OPTIMIZING A METHOD OF DYNAMIC PROGRAMMING
V. G. Boltyanskiy 4 Sep. 1964 46 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mat. (Moscow), v. 28, no. 3, May–Jun. 1964 p 481–514
(JPRS-26273; TT-64-41532) OTS: $2.00

This article presents in detail the problem of optimum control for an object defined by ordinary differential equations. Sufficient conditions for optimizing are derived; one of these conditions gives in fact a correct basis for the method of dynamic programing (for the type of problems being considered). Another condition shows that the principle of maximum, provided that a regular synthesis exists, is not only a necessary but also a sufficient condition of optimum. Examples of synthesis are given for the nonlinear systems of second order. Author

N64-28437 Joint Publications Research Service, Washington, D.C.
SOVIET PAPERS ON VARIATION PROBLEMS AND FLUCTUATION ESCAPE
6 Aug. 1964 11 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR (Kiev), No. 5, 1964
(JPRS-25752; TT-64-41023) OTS: $1.00

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2. ON THE TIME OF A DYNAMIC SYSTEM'S FLUCTUATION ESCAPE FROM A GIVEN FIELD V. M. Goncharenko p 5–8 refs

N64-28440 Joint Publications Research Service, Washington, D.C.
PROBLEMS IN CONTROL THEORY
30 Jun. 1964 16 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 2, 1964
(JPRS-25291; TT-64-31582) OTS: $0.50

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1. THE SYNTHESIS OF OPTIMAL LINEAR SYSTEMS T. G. Babunashvili p 1–7 refs
2. ON THE SYNTHESIS OF LOGICAL NETS IN INCOMPLETE AND NONDEGENERATE BASES E. I. Nechiporuk p 8–12 refs

N64-28441 Joint Publications Research Service, Washington, D.C.
THE SYNTHESIS OF OPTIMAL LINEAR SYSTEMS
T. G. Babunashvili *In its* Prob. in Control Theory 30 Jun. 1964 p 1–7 refs (See N64-28440 20-20) OTS: $0.50

A new method of synthesis, applicable to arbitrary inhomogeneous (nondegenerate) linear systems, is described. The problem is formulated by considering the equation $x = A(t) + B(t)u + f(t)$. Here, x is an n-dimensional phase column vector; A(t) is a summable n × n matrix (i.e., a matrix whose elements are summable on any bounded interval of the time axis); u is the r-dimensional column vector of the control; B(t) is a summable n × r matrix; and f(t) is the n-dimensional column vector. The control u belongs to the class of measurable functions with values in a given compact convex polyhedron of r-dimensional space containing the origin. The problem consists of finding the optimal control for a given initial position x_0 in the phase space that transfers the phase point along the corresponding (optimal) trajectory of the above equation from X_0 to the origin, in minimal time. I.v.L.

N64-28442 Joint Publications Research Service, Washington, D.C.
ON THE SYNTHESIS OF LOGICAL NETS IN INCOMPLETE AND NONDEGENERATE BASES
E. I. Nechiporuk *In its* Prob. in Control Theory 30 Jun. 1964 p 8–12 refs (See N64-28440 20-20) OTS: $0.50

The fundamental problems of cybernetics consist of constructing control systems with given functional properties by the optimal utilization of available means (the basis). A particular case of this problem is the problem of the realization of Boolean functions by logic net works. This report considers the realization of these functions by two types of logic net works— circuits of functional elements and superpositions. I.v.L.

N64-28450 European Atomic Energy Community, Brussels (Belgium)
PROGRAMMING OF THE NON-NUMERICAL PROBLEMS [LA PROGRAMMATION DES PROBLEMES NON NUMERIQUES]
P. Braffort, D. Hirschberg, and J. Mommens Joint Nucl. Res. Center, Ispra Estab. (Italy) Sci. Data Process. Center, Apr. 1964 11p refs In FRENCH; ENGLISH summary
(EUR-365.f; CETIS-31) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 121.86: 25 Belg. Fr.

In numerical programing, arithmetic structure plays a special part, whereas in nonnumerical programing, all structures are treated in an equivalent manner. A programing language for nonnumeric applications should therefore be of a generality such that it can be used for logical applications and for the treatment of the theory of sets. The form of such a language is illustrated by a very simple example taken from the field of mechanical linguistics. The relations between the heuristic and algorithmic concepts are also discussed. Author

N64-28466 Systems Research Labs., Inc., Dayton, Ohio Mathematics Div.
A NEW APPROACH TO COMPUTER COMMAND STRUCTURES Final Report, 30 Mar. 1962–16 Sep. 1963
Clarence Ross et al Griffiss AFB, RADC, May 1964 196 p refs
(Contract AF 30(602)-2741)
(RADC-TDR-64-135; AD-442644)

The purpose of the research was to develop a set of operations and language that allows a mathematician to use a systematic synthesis technique in programing. A set of realizable

operations, the mathematical structure and properties of these operations, and interrelations existing among the operations were developed. A background investigation was performed, and from this investigation characteristics of an ideal digital language were synthesized. The syntax and semantics for a practical basic programing language were developed and refined through applications and examples. Techniques for logical manipulations and minimal programing were investigated. Methods to expand and refine the basic language, enabling convergence of the language to the ideal digital language, were derived. Results indicate that a programing calculus, for rote manipulation of all operations, with minimization techniques, is feasible. Author

N64-28512 Illinois U., Urbana Digital Computer Lab.
HYBRID METHODS FOR INITIAL VALUE PROBLEMS IN ORDINARY DIFFERENTIAL EQUATIONS
C.W. Gear 19 Jun. 1964 28 p refs
(Rept.-164; AD-442311)

Methods for the integration of initial value problems for the ordinary differential equation $dy/dx = f(x,y)$ that are a combination of one-step procedures (e.g., Runge–Kutta) and multistep procedures (e.g., Adams' Method) are discussed. A generalization of a theorem from Henrici proves that these methods converge under suitable conditions of stability and consistency. This, incidentally, is also a proof that predictor–corrector methods using a finite number of iterations converge. Four specific methods of order 4,6,8, and 10 have been found. Numerical comparisons of the first three of these have been made Adams', Nordsieck's, and the Runge–Kutta methods. Author

N64-28640 Chalmers U. of Tech., Goteborg (Sweden)
ON THE USE OF MONTE CARLO METHODS FOR CALCULATING THE DEEP PENETRATION OF NEUTRONS IN SHIELDS
Martin Leimdorfer Goteborg, Scandinavian U. Books, 1964 17 p refs *Its* Trans. No. 287
Scandinavian U. Books: 3 Sw. Kr.

The exponential transformation, previously applied to problems concerning deep penetration of photons in plane geometry, is here applied to problems of deep penetration of neutrons in spherical geometry. The representation of nuclear data is briefly described, and the extension of the exponential transformation technique to spherical geometry is discussed on a quite general basis, to show the proper way of derivation in other systems of coordinates. In a sample problem concerning the dose rate versus distance (up to 210 cm) from a point fission source in concrete, the present method is compared with the moments method, and excellent agreement is shown. Author

N64-28689 Research Inst. of National Defence, Stockholm (Sweden)
A MONTE CARLO METHOD FOR THE ANALYSIS OF GAMMA RADIATION TRANSPORT FROM DISTRIBUTED SOURCES IN LAMINATED SHIELDS
M. Leimdorfer Feb. 1964 36 p refs
(FOA-4-A-4354-411)

A description is given of a method for calculating the penetration and energy deposition of gamma radiation, based on Monte Carlo techniques. The essential feature is the application of the exponential transformation to promote the transport of penetrating quanta and to balance the steep spatial variations of the source distributions appearing in secondary gamma emission problems. The estimated statistical errors in a number of sample problems, involving concrete shields with thicknesses up to 500 cm, are shown to be quite favorable, even at relatively short computing times. A practical reactor shielding problem is also shown and the predictions compared with measurements. Author

N64-28692 Brookhaven National Lab., Upton, N.Y.
A HIGH CAPACITY DIGITAL DATA HANDLING SYSTEM FOR USE WITH COUNTER HODOSCOPES AND DIGITIZED SPARK CHAMBERS IN ON-LINE COMPUTER AGS EXPERIMENTS
K. J. Foley, W. Higinbotham, S. J. Lindenbaum, W. A. Love, S. Ozaki et al 1 Mar. 1964 10 p ref
(BNL-852(T-338)) OTS: $0.50

A new digital data-handling system is described, and its application to experiments planned shortly for the Brookhaven alternating-gradient synchrotron is outlined. The new system, at present, consists of 200 fast gates, two of the 48- × 4,096-bit memory units with associated electronics, two high-speed magnetic-tape transports, and a direct data link to the Merlin computer. The system will be applied to the following experiments: (1) investigations of the elastic scattering of 11- to 30-Bev/c $\pi^{\pm}$, p, $\bar{p}$, and $K^{\pm}$ by protons; (2) investigations of the elastic scattering of 11- to 21-Bev/c $\pi^{\pm}$, p, $\bar{p}$, and $K^{\pm}$ by protons in the $|t|$ range 0.7 to 3 $(Bev/c)^2$; and (3) investigations of multiparticle inelastic interactions. I.v.L.

N64-28758* National Aeronautics and Space Administration, Washington, D.C.
TABLES OF NORMALIZED SPHERICAL FUNCTIONS AND THEIR DERIVATIVES, WITH THE LOGARITHMS OF THEIR VALUES AND FORMULAS FOR EXPANSIONS IN SPHERICAL FUNCTIONS
Adolf Schmidt Jun. 1964 63 p refs Transl. into ENGLISH of the book "Tafeln Der Normierten Kugelfunktionen und Ihrer Ableitungen Nebst Den Logarithmen Dieser Zahlen Sowie Formeln Zur Entwicklung Nach Kugelfunktionen" Gotha (Germany), Engelhard-Reyher Verlag, 1935
(NASA-TT-F-8888) OTS: $6.60 ph

An introductory discussion of associate functions of the spherical functions and of their derivatives is presented for the various function forms (Laplace function, Neumann function, and normalized functions), followed by calculation methods for series expansion in spherical functions. Tables of normalized spherical functions of the first six orders and their logarithms make up the body of this work. M.P.G.

N64-28761* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UNIVAC 1107 EXEC II USER'S MANUAL. MODIFIED VERSION OF THE UNIVAC SYSTEM
Troy J. Davis Jun. 1964 81 p refs
(NASA-TM-X-55040; X-543-64-212) OTS: $8.10 ph

A working guide for the programer using the NASA EXEC II System on the Univac 1107 computer is presented in an attempt to assemble all documentation on this system and any of its component parts into a single manual. As future changes are made to the system, the manual will be updated by distributing revised or additional pages. Therefore, discrepancies between this manual and those prepared by the manufacturer should be resolved in favor of this document. M.P.G.

N64-28882* Rocketdyne, Canoga Park, Calif. Stochastic Processes and Operations Research Unit
A STUDY OF METHODS FOR THE DESIGN AND ANALYSIS OF SENSITIVITY EXPERIMENTS Quarterly Progress Report, 1 Apr.–30 Jun. 1964

13 Jul. 1964 29 p refs
(Contract NAS8-11061)
(NASA-CR-58491; R-5523-2) OTS: $2.60ph

This report summarizes discussions of recent work on the laboratory and literature surveys, design of experiment for the safety problem, coding of the simulation program, maximum likelihood estimates of partially ordered response probabilities, and simultaneous maximum likelihood estimates of location parameters for several sets of sensitivity data. Author

N64-28890* Martin Co., Baltimore, Md. Massachusetts Inst. of Tech., Lexington
ON STOCHASTIC EXTREMUM PROBLEMS: CALCULUS
Harold J. Kusner [1964] 21 p refs Work done in conjunction with MIT Submitted for Publication
(Contracts NASw-845; AF 49(648-1206)
(NASA-CR-58593) OTS: $2.60ph

The Lagrange multiplier technique is a useful and sometimes indispensable technique for solving for stationary points of functions or stationary functions of functionals, when the solutions are subject to subsidiary constraints. The validity of a form of the technique for determining the stationary points (of functions) or stationary functions (of integrals) of the expected value of random functions with certain random constraints is proved. These problems are referred to as the stochastic calculus (or stochastic calculus of variations). The aim of the paper is to prove certain necessary conditions. Author

N64-28967* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EQUIVALENCE CLASSES OF PERIODIC SEQUENCES
Robert C. Titsworth Repr. from Ill. J. Math., v. 8, no. 2, Jun. 1964 p 266–270 refs
(Contract NAS7-100)
(NASA-CR-58245; JPL-TR-32-568)

If two periodic sequences *a* and *a'* can be made alike, either by a shift in origin or a permutation of states or both, how many inequivalent symmetry types of sequences are there? This question is known as the necklace problem, the solution to which is the number of finite-state machines required to generate all sequences having a given period. Formulas and cycle numbers and mathematical computations based thereon are discussed in the light of this solution. A.W.

N64-28977 Chalmers U. of Tech., Goteborg (Sweden)
ON THE TRANSFORMATION OF THE TRANSPORT EQUATION FOR SOLVING DEEP PENETRATION PROBLEMS BY THE MONTE CARLO METHOD
Martin Leimdörfer Goteborg, Scandinavian U. Books, 1964 15 p refs *Its* Trans. No. 286
Scandinavian U. Books: 3 Sw. Kr.

The present report describes a modification of the exponential transformation of the Boltzmann transport equation that removes a singularity in the transformed scattering kernel, discussed by the author in an earlier paper. The effect is obtained by limiting the tracks of the particles to the problem boundary, whereby a zero virtual cross section may be permitted. A sampling technique for the new intercollision distance is given. Author

N64-28981 Space Technology Labs., Inc., Redondo Beach, Calif.
TEST OF INDIRECT METHODS OF ESTIMATING AVAILABILITY PARAMETERS
W. J. Howard Jun. 1964 64 p refs
(Contract AF 04(694)-524)
(Rept.-6444-6042-TU000; AD-602119)

Several methods of estimating availability parameters are described that assume as their basis that data is provided for the number of units passing and failing checkout and for period of time each unit stands between checkout. Each method was tested using data generated by computer simulation. The results of these tests are presented and evaluated. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-27931 Army Chemical Center, Edgewood, Md. Nuclear Defense Lab.
COLD WEATHER DECONTAMINATION STUDY—McCOY IV. PART I
J. L. Meredith, J. C. Maloney, Howell G. Bradbury, and William R. Miller (General/Dynamics, Ft. Worth) Apr. 1964 115 p refs
(Contract OCD-OS-63-21)
(NDL-TR-58; AD-602890) OTS: $4.00

A study is made of radiological decontamination under cold-weather and thawing conditions. The objective is to determine better methods of decontaminating specific surfaces; effectiveness was based on amount of contamination removed and the effort expended. The following results are given: (1) Loose snow can be decontaminated with a blade snowplow or motor grader to less than a remaining 5 percent. (2) Ice can be decontaminated with corn brooms to less than a remaining 5-percent activity. (3) Frozen ground can be decontaminated by mechanical sweeping to a remaining 3-percent activity. (4) Thawing ground can be decontaminated with a bulldozer, carryall scraper, hand shovel, or motor grader to less than a remaining 10-percent contaminant. (5) Dry asphalt, concrete, and macadam can be decontaminated with compressed air, hand corn-broom, fire hose, mechanical sweeper, or vacuum cleaner to less than a remaining 10 percent. J.L.C.

N64-27932 Army Chemical Center, Edgewood, Md. Nuclear Defense Lab.
COLD WEATHER DECONTAMINATION STUDY—McCOY IV. PART II
V. L. Meredith, J. C. Maloney, Howell G. Bradbury, and William R. Miller (Gen. Dynamics/Ft Worth) Apr. 1964 228 p
(Contract OCD-OS-63-21)
(NDL-TR-58; AD-602897) OTS: $6.00

Appendixes, consisting of charts and graphs, are given concerning results of a study of radiological decontamination under cold-weather and thawing conditions. J.L.C.

N64-27934 Joint Publications Research Service, Washington, D.C.
STUDIES IN METEOROLOGY
3 Aug. 1964 113 p refs Transl. into ENGLISH from Meteorol i Gidrol. (Moscow), no. 5, 1964
(JPRS-25-697; TT-64-31969) OTS: $4.00

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3. STATISTICAL EVALUATION OF THE ERRORS ASSOCIATED WITH LINEARIZATION OF THE VORTICITY EQUATION I. L. Vulis p 26–36 refs (See N64-27937 20-21)

4. INCREASING THE QUALITY OF ANALYSIS OF THE GEOPOTENTIAL FIELD FOR AREAS FOR WHICH THERE IS LITTLE AVAILABLE INITIAL DATA M. S. Fuks-Rabinovich p 37–50 refs (See N64-27938 20-21)

5. STABILITY OF SOLUTION OF VORTICITY TRANSPORT EQUATIONS RELATIVE TO INITIAL AND BOUNDARY CONDITION PERTURBATIONS L. A. Dikiy and T. D. Koronatova p 51–59 refs (See N64-27939 20-21)

6. COMPUTATION OF CHANGES IN PRESSURE AT THE EARTH'S SURFACE FROM USING AEROLOGICAL DATA Ye. N. Arabey p 60–67 refs (See N64-27940 20-21)

7. THE CONTRIBUTION OF VERTICAL MOVEMENTS TO THE DEVELOPMENT OF CYCLONES AND ANTICYCLONES N. I. Pavlov p 68–70 (See N64-27941 20-21)

8. THE COMPLEX METHOD AND THE PROBLEM OF LONG-RANGE WEATHER FORECASTING Yu. B. Khrabrov p 71–96 refs (See N64-27942 20-21)

N64-27935 Joint Publications Research Service, Washington, D.C.

A NEW APPROACH TO THE NUMERICAL SOLUTION OF THE WEATHER FORECASTING PROBLEM

G. I. Marchuk *In its* Studies in Meteorology 3 Aug. 1964 p 1–10 refs (See N64-27934 20-21) OTS: $4.00

This report demonstrates the possibility of the full splitting of the principal weather-forecasting equations into a series of very simple problems described by standard algorithms. It appears at the present time that such a method is most effective in the mathematical modeling of weather-forecasting equations that are becoming increasingly complex as a result of new physical factors. I.v.L.

N64-27936 Joint Publications Research Service, Washington, D.C.

CERTAIN CHARACTERISTICS OF TROPOSPHERIC CIRCULATION IN THE EQUATORIAL REGION

Ye. M. Dobryshman *In its* Studies in Meteorology 3 Aug. 1964 p 11–25 refs (See N64-27934 20-21) OTS: $4.00

Processes of a synoptic scale were studied in the greatest detail in extratropical regions. In the tropical zones, where there are far fewer observations, a detailed study was made of the most clearly manifested characteristic processes—monsoons, trade winds, typhoons, etc. Recently developed research methods for investigation of the atmosphere and the voyages of special weather ships have made it possible to understand considerably more clearly the pattern of circulation in the low latitudes. Author

N64-27937 Joint Publications Research Service, Washington, D.C.

STATISTICAL EVALUATION OF THE ERRORS ASSOCIATED WITH LINEARIZATION OF THE VORTICITY EQUATION

I. L. Vulis *In its* Studies in Meteorology 3 Aug. 1964 p 26–36 refs (See N64-27934 20-21) OTS: $4.00

One of the initial equations of a barotropic model in numerical forecasting is the vorticity equation $\Delta(\delta\psi/\delta t) - (1/L_0^2)(\delta\psi/\delta t) + j(\psi, \Delta\psi + L) = 0$, where ψ is the current function. The symbol $j(A,B) = (\delta A/\delta X) \cdot (\delta B/\delta y) - (\delta A/\delta y) \cdot (\delta B/\delta X)$ denotes the Jacobian, and x, y is a standard coordinate system. This report uses mathematical statistics to evaluate the errors associated with the linearization of the vorticity equation in different parts of the spectrum of atmospheric movements. I.v.L.

N64-27938 Joint Publications Research Service, Washington, D.C.

INCREASING THE QUALITY OF ANALYSIS OF THE GEOPOTENTIAL FIELD FOR AREAS FOR WHICH THERE IS LITTLE AVAILABLE INITIAL DATA

M. S. Fuks-Rabinovich *In its* Studies in Meteorology 3 Aug. 1964 p 37–50 refs (See N64-27934 20-21) OTS: $4.00

A method of dynamic analysis is discussed. A region from which no information is received (or a region under conditions from which data are received from a very thin network of stations) is referred to as region A. The surrounding region, for which ample observational data are available, is referred to as region B. For region B there are several methods of objective analysis that give good results. The forecast for region B, based on good initial information, therefore gives better results than for region A, for which little or no data are available. Over the region A + B, there is a movement of airmasses, and part of the airmass initially situated over region B will pass over region A, thereby furnishing for this region certain additional information that is more complete than the initial information from region A. Such a redistribution of information makes it possible to improve the quality of the analysis of the geopotential field for the poorly reported region A. I.v.L.

N64-27939 Joint Publications Research Service, Washington, D.C.

STABILITY OF SOLUTION OF VORTICITY TRANSPORT EQUATIONS RELATIVE TO INITIAL AND BOUNDARY CONDITION PERTURBATIONS

L. A. Dikiy and T. D. Koronatova *In its* Studies in Meteorology 3 Aug. 1964 p 51–59 refs (See N64-27934 20-21) OTS: $4.00

A source of errors of considerable importance in the forecasting of the pressure field by numerical methods is the use of fictitious boundary conditions. These errors obviously increase with an increase in the forecasting period. This report demonstrates, by means of an example of a very simple barotropic model, how rapidly such errors are propagated from the boundary into the forecasting region, and thereby establishes the period of time a forecast for a limited region is reasonable. I.v.L.

N64-27940 Joint Publications Research Service, Washington, D.C.

COMPUTATION OF CHANGES IN PRESSURE AT THE EARTH'S SURFACE FROM USING AEROLOGICAL DATA

Ye. N. Arabey *In its* Studies in Meteorology 3 Aug. 1964 p 60–67 refs (See N64-27934 20-21) OTS: $4.00

On the basis of radiosonde data processing, an analysis is made of the effect of a change of air density in different layers of the atmosphere ("layer" contributions) on the change of pressure at the earth's surface. Results indicate that, on the average, the major role in the change of surface pressure among the principal isobaric layers is played by the layer 300–100 mb, where the pressure disturbances are greater than at the earth's surface. This can explain the well-known fact that the trajectories of regions of pressure change at the earth's surface are simpler than the trajectories of cyclones and anticyclones and that they are often linear for a great distance. I.v.L.

N64-27941 Joint Publications Research Service, Washington, D.C.
THE CONTRIBUTION OF VERTICAL MOVEMENTS TO THE DEVELOPMENT OF CYCLONES AND ANTICYCLONES
N. I. Pavlov *In its* Studies in Meteorology 3 Aug. 1964 p 68–70 (See N64-27934 20-21) OTS: $4.00

The vertical velocity at the center of the cyclone was determined, using the formula $dp/dt = \partial p/\partial t + W(\partial p/\partial z)$ as the difference between the individual and local pressure change, divided by the vertical pressure gradient. In the computations it was assumed that $\partial p/\partial z = 1$ mb/10 m; this corresponds approximately to a height of 2 to 2.5 km. In those cases when the rate of movement of the cyclone (anticyclone) is equal to zero, the following equality will apply $dp/dt = \partial p/\partial t$.; that is, the development of pressure formations in this case is caused only by a local pressure change. For the deepening of a moving cyclone, it is necessary that $W(\partial p/\partial z)$ be greater in absolute value than $\delta p/\gamma$, and for its filling, less than $\delta p/\delta t$. In the case of the development of moving anticyclones, the picture will be the reverse of the picture for cyclones. In the moving centers of anticyclones, the local change of pressure in most cases has a negative sign (except in the case of nearly stagnant anticyclones). I.v.L.

N64-27942 Joint Publications Research Service, Washington, D.C.
THE COMPLEX METHOD AND THE PROBLEM OF LONG-RANGE WEATHER FORECASTING
Yu. B. Khrabrov *In its* Studies in Meteorology 3 Aug. 1964 p 71–96 refs (See N64-27934 20-21) OTS: $4.00

A complex method of long-range forecasting is reviewed that consists of individual methods as follows: Method 1 is based on the use of wave variations in the pattern of general circulation of the atmosphere in the Northern Hemisphere. Method 2 uses the successive change of the character of the temperature field over Eurasia over long periods of time. Method 3 is based on the use of the character of the circulation over the Northern Hemisphere in the preceding month as an argument. Method 4 employs the character of repetition of certain types of atmospheric macroprocesses. Method 5 is based on the use of the succession in transformation of the macroprocesses of synoptic seasons. Tabular data are presented on the probability of success of the complex method and of the individual forecasting methods included in it, during the warm and cold half-years, for predictions of the temperature anomaly for the coming month. I.v.L.

N64-27947 Colorado State U., Fort Collins
EXPERIMENTS IN OBJECTIVE UPPER-WIND ANALYSIS AND FORECASTING Final Report
Elmar R. Reiter and Patricia E. White Jul. 1964 158 p refs *Its* Atmospheric Sci. Tech. Paper No. 50
(Contract ARDS-450)
(RD-64-101)

The purpose and scope of the study are outlined, and some of the earlier work is reviewed. The objectives of the research program are classified into (1) data handling, (2) objective analysis, and (3) objective forecasting of parameters characterizing the layer of maximum wind (LMW). The data handling aspects are described. Error checking and harmonic analysis of vertical wind profiles are discussed. Computer programs in FORTRAN for an IBM 7090 are included. A method of objective horizontal analysis of LMW parameters is discussed, which is based on the concept of fitting a quadratic function to station observations in order to arrive at grid point data. Machine programs, again, are listed. A detailed outline is given of various approaches to 12- and 24-hour kinematic extrapolation forecasts. Skill evaluations are presented in comparison to persistence. Various smoothing techniques on input and output have been tested as to their effect in reducing forecasting errors. Author

N64-28021 Joint Publications Research Service, Washington, D.C.
SOME RESULTS OF RADAR MEASUREMENTS OF TURBULENCE IN A FREE PURE ATMOSPHERE
A. A. Zagorodnikov 24 Aug. 1964 7 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, (Moscow), v. 156, no. 2, 21 Jun. 1964 p 1336–1338
(JPRS-26086; TT-64-41356) OTS: $1.00

The parameters of the radiation patterns, pulse, and nonlinearity of the detector channel of a radar set affect the recording results of the density distributions of the reflectors in the cloud. In processing the experiments, all these factors that distort the results of the measurements must be considered. Successive measurements of the density distribution of the reflectors along the appropriate directions make it possible to judge the rate of the scattering of the cloud and, consequently, the magnitude of atmospheric turbulence. The processing of the experimental data makes it possible to make a number of conclusions concerning the nature of the diffusion of a contaminant in a turbulent atmosphere. On the horizontal plane, the scattering occurs approximately uniformly in all directions, and the rate of scattering on the vertical plane is somewhat less. Author

N64-28047 Joint Publications Research Service, Washington, D.C.
A DYNAMIC ANALYSIS ON THE DEVELOPMENT OF CUMULO-NIMBUS INCUS
L. Hsing-cheng, Ch'ao Chi-p'ing, and Hu Yin-Ch'iao *In its* Transl. on Communist China's Sci. and Technol. No. 100 30 Jul. 1964 p 59–62 refs (See N64-28041 20-07) OTS: $3.00

When a convection cloud is at the maturity stage, on the deck of the cloud there frequently occurs the formation of a cumulonimbus incus. As revealed from current observations, the cumulonimbus incus can be considered as a warm cloud. In this article, a dynamic analysis is made of the causes of the formation of the incus structure. Author

N64-28154 United Electrodynamics, Inc., Alexandria, Va.
WEATHER-SEISMIC-NOISE CORRELATION STUDY Final Report
J. C. Bradford, R. H. Shumway, and J. N. Griffin 31 Jul. 1964 166 p refs
(Contracts AF 19(628)-230; ARPA-Order-180-61, Amend. 173, Proj. Vela-Uniform)
(AFCRL-64-607; AD-444069)

An analysis program was initiated to establish correlations of meteorological conditions with seismic noise in the 0.5- to 2-sec period range. The seismic and meteorologic data to be correlated were provided from recordings that were made in California and the Pacific Northwest. The correlation of the data was approached primarily from a statistical (rather than physical) viewpoint. Several hundred correlation coefficients were calculated between seismic noise level and five weather parameters. These showed that possible significant parameters were wind, temperature, pressure, and humidity. A stepwise multiple regression program was then employed to reveal those weather parameters whose significance did not depend upon possible interaction with other parameters.

This showed that wind speed and temperature were both significantly related to average noise level, although the effect of temperature was negligible. Strong local wind was unquestionably related to average noise level, in the period range 0.5 to 2.0 seconds. Author

N64-28436 Joint Publications Research Service, Washington, D.C.
METEOROLOGICAL OBSERVATIONS AND INSTRUMENTATION
4 Aug. 1964 69 p refs Transl. into ENGLISH of 12 selected articles from Meteorol. i Gidrol. (Moscow), no. 6, Jun. 1964 (JPRS-25718; TT-64-31990) OTS: $3.00

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5. ACCURACY OF WIND DETERMINATION USING THE "METEOR" RADIOMETEOROLOGICAL STATION B. S. Derbenev and B. P. Istomin p 32–36 refs
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11. METEOROLOGICAL CONFERENCES, MEETINGS AND SEMINARS IN THE USSR p 63–65
12. FOREIGN METEOROLOGICAL ACTIVITIES NOTED IN SOVIET JOURNAL p 66

N64-28467 Freie U., Berlin (W. Germany) Inst. für Meteorologie und Geophysik
DAILY AND MONTHLY NORTHERN HEMISPHERE 10-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1964. PART I: JANUARY–MARCH First Quarterly Technical Status Report
Barbara Kriester, Richard Scherhag, and Renate Stuhrmann Berlin, Dietrich Reimer, 1964 108 p *Its* Meteorologische Abhandlungen Vol. IL, No. 1
(Contract DA-91-591-EUC-3288)
(AD-421059) Available from Verlag von Dietrich Reimer, Drakestrasse 40, Berlin 45: 15 DM

A description and maps of the upper stratospheric circulation during the first quarter of 1964 are presented. Both mean monthly maps and daily 10-millibar synoptic weather maps for the Northern Hemisphere are included. M.P.G.

N64-28468 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE ACCURACY OF RADAR MEASURING THE ALTITUDE OF CLOUDS
A. M. Borovikov and V. V. Kostarev 18 Jul. 1963 10 p Transl. into ENGLISH from Tsentr. Aerol. Observ. (USSR), no. 36, 1961 p 37–42
(FTD-TT-63-539/1+2; AD-414640)

The results of comparative radar and aircraft observations of the altitude of cloud boundaries are discussed. It was found that, with the aid of a radar station, it is possible to measure the upper boundaries of clouds with an accuracy of ±100m. The advantage of employing the radar method for measuring the altitude of the lower cloud boundaries is also discussed. R.T.K.

N64-28601 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
THE LIGHTNING DISCHARGE
Heinz W. Kasemir May 1964 41 p refs
(USAEL-2401; AD-603388)

The stationary electric field inside a thunderstorm, which is generated by the movement of charged precipitation particles, causes the lightning discharges. In the electric field of the lightning stroke, the distribution of the stationary field in the cloud is reflected. This report shows how different types of lightning strokes (cloud or ground discharges) are connected with different kinds of field distributions in the thundercloud. This leads to certain conclusions of the precipitation pattern and the development stage of the thunderstorm. Electric field and sferics records of different types of thunderstorms are discussed, and useful parameters in the field records are pointed out to determine characteristic electric features of the thunderstorm. Author

N64-28610 Oslo U., Blindern (Norway) Inst. of Theoretical Meteorology
SOME STABILITY PROPERTIES OF A MATERIAL LAYER MODEL OF THE ATMOSPHERE
William Blumen 1 Feb. 1964 20 p refs
(Contract AF 61(052)-525)
(TN-5; AFCRL-64-505; AD-603042)

Some baroclinic stability properties of an atmospheric two-layer model, in which the bottom layer is bounded by two constant potential temperature surfaces, were investigated. The perturbation method is employed, and the motion takes place on the β-plane. Curves of neutral stability are constructed for three different cases and the results discussed. Author

N64-28616 Agricultural Research Service, Ithaca, N.Y.
THE ENERGY BUDGET AT THE EARTH'S SURFACE, PART II Production Research Report No. 72
Edgar R. Lemon et al Sep. 1963 55 p refs Prepared in Cooperation with Cornell U. and Therm, Inc.
(Sponsored by Army)

The following are discussed: "Effects of Turbulence and Photosynthesis on CO_2 Profiles in the Lower Atmosphere"; "Quasi-Steady Micro-Meteorological Atmospheric Boundary Layer over a Wheatfield"; A Study of Atmospheric Turbulence and Canopy Flow"; "A Method for the Computation of Logarithmic Wind Profile Parameters and Their Standard Errors"; and "Turbulent Transfer Characteristics of the Air-Stream in and above the Vegetative Canopies at the Earth's Surface." R.T.K.

N64-28661 Brookhaven National Lab., Upton, N.Y.
A DIFFUSION-DEPOSITION TRACER SYSTEM
Gilbert S. Raynor and Maynard E. Smith Apr. 1964 21 p refs
(BNL-859(T-343)) OTS: $0.50

A dual tracer technique has been developed for use in experiments in low-level atmospheric dispersion and deposition. It permits definition of the airborne concentrations of a cloud of small particles representative of a true aerosol and simultaneously the deposition of larger particles on the soil and vegetation beneath. The deposition tracer consisting of Cu^{64} particles in the 1μ to 10μ range can be detected directly on the surface without the intervention of any artificial collecting mechanism or the necessity of inferring deposition by mass balance techniques. Techniques, instruments, and facilities for the preparation, activation, emission, sampling, and measurement of both tracers are described in sufficient detail to permit reproduction. Author

N64-28702 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE AD 3.514 Meteorological Data Report, 30 Mar. 1964
Marjorie Mc Lardie Hoidale Apr. 1964 41 p
(ERDA-136; AD-443884)

Meteorological data gathered for the launching of Aerobee AD 3.514 are presented, along with calculated ballistic data. Author

N64-28704 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AEROBEE NASA 4.15 GG Meteorological Data Report, 2, Apr. 1964
Marjorie Mc Lardie Hoidale May 1964 45 p refs For Abstract see N64-28702 20-21
(ERDA-139; AD-443887)

N64-28780 Meteorology International Inc., Monterey, Calif.
RADIATIVE-HEATING FORMULATIONS FOR DYNAMICAL NUMERICAL MODELS OF THE ATMOSPHERE Technical Summary Report
Manfred M. Holl Jun. 1964 23 p refs
(LRL Order 7128805)

Based on a conceptual simplification of cloudiness the radiative-transfer equations for water vapor are modified to include a variable cloud-substance structure. The resulting expressions of the upward and downward fluxes of long-wave energy are developed in forms that can be evaluated using available tables for the generalized transmission functions for water vapor. Author

N64-28799 American Meteorological Society, Boston, Mass.
CLIMATIC CHANGE AND CLIMATE CONTROL [IZMENENIE KLIMATA I PUTI EGO PREOBRAZOVANIIA]
M. I. Budyko Bedford, Mass., AFCRL, Apr. 1964 10 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, 1962 p 33–37
(Contract AF 19(628)-3880)
(T-R-436+; AD-602189)

Climate change and climate control are discussed. The heat-balance method is now employed, together with certain other methods of theoretical climatology, for investigating the laws of natural climatic changes and for determining the possibility of controlling such changes. This method can be employed to solve a number of problems that arise in the study of temperature-zone changes, including the reason for the present large unfavorable air-temperature differences between the equator and the poles. For example, it is indicated that the ice covers of the Arctic and Antarctic are more the cause than the result of the low temperature of the high latitudes. The artificial formation of precipitation by seeding with dry ice, or other reagents, offers the most immediate prospects for climate control. Data are also available on the possibility of changing the thermal regime of the atmosphere by the artificial modification of clouds. Another means of modifying the precipitation regime involves a change in state of the underlying surface. Other methods of modifying the climate are discussed. I.v.L.

N64-28865 Air Proving Ground Center, Eglin AFB, Fla.
LOW-LEVEL, FINE-SCALE WIND DETERMINATION BY CAPTIVE BALLOONS
William O. Banks May 1964 26 p
(APGC-TDR-64-24; AD-601944)

A flexible, inexpensive micrometeorological network using captive balloons is described. Captive balloon anemometry is compared to pibal and tower methods of measuring winds aloft. Correlation coefficients are computed between measurements made, using four captive balloons and a 50-ft tower. Author

N64-28866 Weapons Research Establishment (Australia) Dept. of Supply
ATMOSPHERIC OZONE MEASUREMENTS FOR SALISBURY, SOUTH AUSTRALIA
B. G. Hunt Apr. 1964 25 p refs
(WRE-TN-PAD-86)

Atmospheric ozone measurements for Salisbury, 34° 43′ S, 138° 39′ E, are presented and compared with similar measurements for Srinagar, 34° 6′ N, 74° 54′ E, and Aspendale, 38° 2′ S, 145° 6′ E. The measurements for Salisbury correspond closely with those for Srinagar, but show marked differences both in total ozone amount and vertical ozone distribution from those for Aspendale. It is thought that this difference is due to the presence of the subtropical jet stream and the associated tropopause gap existing in the latitude region 30° to 35° S. The evidence available for downward mass transfer in this region is discussed in relation to the ozone measurements for Salisbury and Aspendale. Author

N64-28930* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRATOSPHERIC TEMPERATURE PATTERNS BASED ON RADIOMETRIC MEASUREMENTS FROM THE TIROS VII SATELLITE
W. Nordberg, W. R. Bandeen, G. Warnecke, and V. Kunde May 1964 52 p refs
(NASA TM X-55045; X-651-64-115) OTS: $5.60 ph

The TIROS VII meteorological satellite carried a sensor to map the emitted terrestrial radiation in the 15μ carbon dioxide band. The spectral response of the sensor ranged from 14.8μ to 15.5μ. The radiation observed by the satellite is a function of the temperatures of the atmosphere varying along the optical path. Atmospheric layers at various altitudes contribute to the observed radiation in varying amounts. Temperature patterns were analyzed. The measurements demonstrate on a global scale the varying patterns of stratospheric temperatures and circulation. Smooth temperature gradients were found to coincide closely with latitudinal circles on both summer hemispheres. Temperatures increased at high latitudes toward the summer pole (250° K) and rapidly decreased toward the winter pole (200° K). Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-28001 Consiglio Nazionale Delle Richerche, Rome (Italy) Instituto Nazionale Per Le Ricerche Spaziali

DYNAMICAL RESPONSE OF THE S. RITA PLATFORM; ITS EFFECTS UPON THE SCOUT GUIDANCE SYSTEM ACCURACY

Gianfranco Manarini Apr–May 1964 46 p

This report examines the practical data concerning the dynamic response of the Santa Rita launch platform to the natural external elements (sea waves and wind) and to the action of the rotating equipment aboard the platform. The movements of the launch platform, during alignment of the reference system, during guidance system checkout, and at the exact moment the integrating gyros are exchanged, affect the accuracy of the satellite orbit. Discussed are the electronic system used, tests performed, data obtained, and dynamic platform response as the integrating gyros are uncaged. E.K.R.

N64-28068* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.

SUMMARY OF EXPERIMENTAL ASTRONOMY LABORATORY WORK

Jun. 1964 68 p refs Reprints of talks given at a meeting held at MIT, 14 Apr. 1964

(Grant NsG-254-62)

(NASA-CR-58332; PR-1) OTS: $6.60 ph

The LLAMA (Low Level Acceleration Measurement Apparatus) program is described. It consists of an investigation of techniques for refining the various components of a simple single-axis linear accelerometer, for constructing an exceptionally sensitive device to be used as a calibration standard in the test and evaluation of other instruments. Statistical techniques in the designing of inertial guidance components and studies of the effect of noise in optical line-of-sight determinations are presented. A numerical evaluation of several simplified mathematical models for achieving interplanetary midcourse guidance was obtained, and simple, basic principles involved in the navigation of a manned spaceship during an interplanetary trip to Venus or Mars are presented. R.T.K.

N64-28988* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.

A GUIDANCE-NAVIGATION SEPARATION THEOREM

James E. Potter Aug. 1964 28 p refs

(Grant NsG-254-62; Contract DSR-5007)

(NASA-CR-58341; RE-11) OTS: $2.60 ph

A trajectory control system for a space vehicle may be divided into two subsystems—the navigation subsystem that filters noisy navigation measurements in order to generate estimates of the vehicle's position, velocity, and mass, and the guidance subsystem that uses this information to generate commands for the vehicle propulsion system in order to accomplish the assigned mission with a minimum cost. Generally, to obtain an optimum control system it is necessary to coordinate the design of the two subsystems so that the guidance subsystem is as insensitive as possible to the expected navigation errors and the type of errors produced by the navigation subsystem has the least effect on guidance. However, in the somewhat idealized case when the vehicle dynamical equations are linear and the cost function is quadratic, the separation theorem states that the optimum control system is obtained when the guidance and navigation subsystems are designed separately without considering their interaction. This result was obtained for sampled data control systems by Gunkel and Joseph and is extended to continuous time control systems in the present paper. Author

N64-29004* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PLANETARY APPROACH GUIDANCE

C. R. Gates and H. J. Gordon 30 Jun. 1964 18 p refs

(Contract NAS7-100)

(NASA-CR-58236; JPL-TR-32-631) OTS: $1.60 ph

Planetary approach guidance, an onboard optical guidance system for a planet-bound spacecraft, functions as the spacecraft approaches the target planet. Such a system should attain an accuracy greater than that obtainable from Earth-based radio guidance. The need for planetary approach guidance is discussed, a set of orbital parameters especially developed for the problem is presented, and analytic differential corrections are derived. Covariance matrices for orbital parameters are given. A specific mechanization is discussed, measurement errors are described, and parametric curves showing accuracy are presented. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-27869* Wisconsin U., Madison Theoretical Chemical Inst.

QUANTUM EFFECTS IN ELASTIC MOLECULAR SCATTERING

Richard B. Bernstein 1 Jun. 1964 100 p refs

(Grant NsG-275-62(4180)

(NASA-CR-56897; WIS-TCI-47) OTS: $8.60 ph

Summaries are presented of the classical treatment of potential scattering and quantum scattering treatment. The radial wave function and phase shifts are the approximation methods given. Also included are the scattering amplitude, the interference pattern, rainbow scattering, low-angle scattering, glory interference effect at low angles, total elastic cross section, extrema in total cross sections, maxima in impact spectra and the bound states, and the influence of concurrent inelastic processes. G.D.B.

N64-27893* Ling-Temco-Vought, Inc., Dallas, Tex. Research Center

INVESTIGATION OF BREMSSTRAHLUNG PRODUCED BY THE INTERACTION OF ELECTRONS WITH MATTER Final Report

W. E. Dance, L. L. Baggerly, N. E. Chappell, B. J. Farmer, J. H. Johnson et al Jun. 1964 64 p refs

(Contract NASw-647)

(NASA-CR-58178; Rept.-0-71000/4R-14) OTS: $6.60 ph

The subject of this study is the electromagnetic radiation, or bremsstrahlung, produced when energetic electrons interact with matter in bulk. The energies of the incident electrons ranged from 0.5 to 3.0 Mev—the electrons had a kinetic energy of the same order as their rest energy. Apparatus, targets, calibration procedures, and data processing are aspects of the experimental method that are discussed. Results are presented in graphic form. G.D.B.

N64-27903* Wisconsin U., Madison Theoretical Chemistry Inst.

SOME NOTES ON GAUGE INVARIANCE

Saul T. Epstein 9 Jun. 1964 13 p refs

(Grant NsG-275-62(4180))

(NASA-CR-56788; WIS-TCI-52) OTS: $1.60 ph

The canonical procedure for introducing a static magnetic field into the electronic Hamiltonian (ignoring spins) is discussed. It is shown that the uncoupled Hartree–Fock approximation is intrinsically not gage invariant, since the nonlocal potential is fixed independently of the magnetic field. It is proved that the coupled (unrestricted) Hartree–Fock theory is invariant to proper gage transformations because the nonlocal potential does respond to the magnetic field. P.V.E.

N64-27948 Oak Ridge National Lab., Tenn. Thermonuclear Div.

ATOMIC AND MOLECULAR COLLISION CROSS SECTIONS OF INTEREST IN CONTROLLED THERMONUCLEAR RESEARCH

C. F. Barnett, J. A. Ray, and J. C. Thompson Aug. 1964 334 p refs

(Contract W-7405-ENG-26)

(ORNL-3113, REV.) OTS: $4.00

A graphical compilation is presented of atomic and molecular cross sections of interest to controlled thermonuclear research. The cross sections are shown, as a function of energy, for collision processes involving molecular ion dissociation, charge exchange, excitation, ionization, photoionization, scattering, energy loss, secondary products, and recombination. Pertinent nuclear cross sections are also included. A bibliography is given covering the literature since 1950. Author

N64-27974 Rochester U., N.Y.

QUADRATIC MASS FORMULA IN SU (3)

S. Okubo and C. Ryan 8 Jul. 1964 11 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-44)

The mass formula in the unitary symmetry model is well satisfied by the squares of the masses in the case of bosons and by the masses themselves in the case of baryons. The ordinary derivation of the mass formula is not relativistically invariant. This follows from the fact that the expectation value of the Hamiltonian is computed in a given Lorentz frame, and the resulting relation holds not for the rest masses but for the energies of the particles concerned. In this note, a method of circumventing this difficulty is presented, and it is shown that the mass formula should be evaluated in quadratic form rather than in the linear one, for all particles. Author

N64-27976 Joint Publications Research Service, Washington, D.C.

ENGINEERING JOURNAL, NO. 1, 1964

28 Jul. 1964 180 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), v. iv, no. 1, 1964

(JPRS-25622; TT-64-31894) OTS: $5.00

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1. OPTIMUM AERODYNAMIC MANEUVER FOR CHANGE OF ORBITAL PLANE DURING NEAR CIRCULAR SPEEDS I. O. Mel'ts p 1–11 ref (See N64-27977 20-02)

2. A THEORY OF TRANSSONIC GAS FLOWS I. M. Yur'yev p 12–23 refs (See N64-27978 20-02)

3. OSCILLATIONS OF CROSS-SHAPED WINGS OF FINITE SPAN IN A COMPRESSIBLE FLOW B. I. Firdlender p 24–38 refs (See N64-27979 20-03)

4. THE EFFECT OF HEAT EXCHANGE AND TURBULENT FLOW IN THE REGION OF MIXING ON CHARACTERISTICS OF BREAKDOWN ZONES V. Ya. Neyland p 39–49 refs (See N64-27980 20-11)

5. INTERACTION OF ATOMS WITH THE SURFACE OF A SOLID A. I. Yerofeyev p 50–63 refs (See N64-27981 20-11)

6. CALCULATION OF A VERY LONG CYLINDRICAL SHELL BY THE METHOD OF SUPERPOSITION D. A. Royak p 64–76 refs (See N64-27982 20-33)

7. A METHOD FOR SOLUTION OF BASIC SPACIAL PROBLEMS OF THE THEORY OF POTENTIAL AND THE THEORY OF ELASTICITY FOR REGIONS BOUNDED BY TWO CLOSED SURFACES P. I. Perlin p 76a–90 refs (See N64-27983 20-23)

8. THE STABILITY OF A DISK SUPPORTING A GYROSCOPE I. M. Mindlin p 91–96 refs (See N64-27984 20-23)

9. EXACT SOLUTION OF A GAS DYNAMICS PROBLEM ABOUT THE MOTION OF A PISTON M. D. Ustinov p 97–102 refs (See N64-27985 20-11)

10. SOLUTION OF A PROBLEM CONCERNING THE OSCILLATIONS OF A FLUID IN A TANK BY THE METHOD OF PERTURBING THE SHAPE OF THE BOUNDARY G. A. Shadrin p 103–109 refs (See N64-27986 20-11)

11. PROPAGATION OF SOUND WAVES IN A POROUS MEDIUM SATURATED WITH GAS AND HAVING A RIGID SHELL P. P. Zolotarev p 110–125 refs (See N64-27987 20-23)

12. MECHANICS OF COSMIC FLIGHT WITH SMALL THRUST. III G. L. Grodzovskiy, Yu. N. Ivanov, and V. V. Tokarev p 126–176 refs (See N64-27988 20-27)

N64-27983 Joint Publications Research Service, Washington, D.C.

A METHOD FOR SOLUTION OF BASIC SPACIAL PROBLEMS OF THE THEORY OF POTENTIAL AND THE THEORY OF ELASTICITY FOR REGIONS BOUNDED BY TWO CLOSED SURFACES

P. I. Perlin *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 76a-90 refs (See N64-27976 20-23) OTS: $5.00

D. I. Sherman's method of solving plane problems of the theory of potential for doubly connected regions is extended to biharmonic problems and is applied to the plane problem of the theory of elasticity. Sherman's method is generalized to the spacial problems of the theory of potential and the theory of elasticity. The application of the formalism of analytical functions turns out to be impossible here. In this generalization, a somewhat leading notion can be drawn from the fact that the auxiliary function, which is of fundamental importance, coincides with the normal derivative of the unknown function, with a precision up to a constant factor after it is differentiated along an arc of the curve l_2. Therefore, the auxiliary function introduced in this paper is taken equal to the normal derivative of the unknown function. This makes it possible to use the methods of the potential theory to arrive at the required result in three-dimensional harmonic and more complex boundary-value problems. I.v.L.

N64-27984 Joint Publications Research Service, Washington, D.C.
THE STABILITY OF A DISK SUPPORTING A GYROSCOPE
I. M. Mindlin *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 91–96 refs (See N64-27976 20-23) OTS: $5.00

The equations of motion for the system under study are derived and solved. The system of coordinates, Gxyz, was selected to study the motion of the gyroscope with respect to the center of mass G, where Gz is the axis of symmetry of the system, Gy coincides with the line of the largest slope of the plane of the disc and is directed upwards, and axis Gx is perpendicular to the plane Gyz. Following the solution of the equations of motion, the following sufficient condition for the stability of the disc is obtained, based on the Lyapunov theorem: $(Cr_0 + Bp_0)^2 + Ma^2(Cr_0 + Bp_0)\, r_0 - MgaA > 0$, where C is the moment of inertia of the disc, Bp_0 is a constant (the kinetic moment of the gyroscope with respect to its axis), M is the mass of the system, a is the radius of the disc, A is the moment of inertia of the system with respect to the diameter of the disc, and p and r are projections of the angular velocity of the disc on the axes Gx and Gz, respectively. If the disc or gyroscope does not rotate, or if the gyroscope is missing, then the condition for stability takes the form $B^4p_0^2 - MgaA > 0$ and $C(C + Ma^2)r_0^2 - MgaA < 0$. I.v.L.

N64-27987 Joint Publications Research Service, Washington, D.C.
PROPAGATION OF SOUND WAVES IN A POROUS MEDIUM SATURATED WITH GAS AND HAVING A RIGID SHELL
P. P. Zolotarev *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 110–125 refs (See N64-27976 20-23) OTS: $5.00

This report on the propagation of sound waves in a porous medium, saturated with a gas and having a rigid shell, considers the porous framework to be absolutely rigid; however, the effect of temperature is taken into account. The equations for the preservation of mass and momentum are written out only for the gaseous phase. An analysis of certain fundamental equations is performed, taking into consideration the periodic waves traveling in the direction of the x-axis. The rate of propagation and the attenuation factor of flat sound waves is found, and an attempt is made to find an expression for heat flow, suitable for small or large frequencies. I.v.L.

N64-27996 Utah U., Salt Lake City Microwave Devices Lab.
CONSOLIDATED QUARTERLY REPORT, JANUARY 1, 1964–MARCH 31, 1964
31 Mar. 1964 80 p refs
(Contracts Nonr-1288(05); AF 04(647)-745; AF 33(657)-8677; DA-039-AMC-02372(E))
(MDL-Q8; AD-601869)

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1. ELECTRON BEAM STUDIES L. S. Bowman, O. Barker, and R. W. Grow et al p 1–32 refs (See N64-27997 20-09)
2. QUANTUM STUDIES V. R. Johnson and R. W. Grow et al p 33–67 refs (See N64-27998 20-23)
3. PLASMA STUDIES P. O. Berrett and C. C. Johnson et al p 68–77 ref (See N64-27999 20-24)

N64-27998 Utah U., Salt Lake City Microwave Devices Lab.
QUANTUM STUDIES
V. R. Johnson, R. W. Grow et al *In its* Consolidated Quart. Rept., Jan. 1–31 Mar. 1964 31 Mar. 1964 p 33–67 refs (See N64-27996 23-20)

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1. IRRADIATED LASER MATERIALS V. R. Johnson and R. W. Grow p 33–60 refs
2. TUNNELING STUDIES M. D. Crawford and R. W. Grow p 60–62
3. MILLIMETER WAVE MASERS J. C. Clark and R. W. Grow p 62–64 refs
4. GAS LASER STUDIES S. C. Carr, M. H. Dittmore, and R. W. Grow p 65–67

N64-28030 Aeronautical Research Council (Gt. Brit.)
THE MEASUREMENT OF ABSORPTIVITY AND REFLECTIVITY
E. T. de la Perrelle and H. Herbert London, HMSO, 1962 22 p (ARC-CP-601; previously issued as RAE-TN-RAD-ARC-20879) HMSO: 3s

To deduce the absorptivity from a measurement of reflectivity, it is necessary to measure the reflectivity in such a manner that both diffuse and specular reflection are correctly included. A method of doing this is described that makes use of a modified integrating sphere. Results were obtained for a variety of materials from wavelengths ~0.33μ to 2.3μ. Author

N64-28066 Weapons Research Establishment (Australia) Australian Defence Scientific Service
VARIATION OF OPTIMUM FOCUS WITH APERTURE IN ABERRATED OPTICAL SYSTEMS
F. A. Dixon and R. E. Little Jan. 1963 29 p refs
(WRE-TN-OID-32)

A theoretical treatment is presented to show that a lens, which has large aberration coefficients and has been focussed at a certain aperture, can give an inferior image if it is used at some other aperture without change of focus. Results are given for a 50-cm focal length F/4.8 Zeiss "Fliegertruppe" Triplet lens, which was tested for its spread function and its frequency response function at various apertures and foci. These show the order of image degradation resulting when such a lens is operated in this way. Author

N64-28072 Library of Congress, Washington, D.C. Aerospace Information Div.
TWO CONTRIBUTIONS OF O. B. FIRSOV TO ATOMIC SPECTROSCOPY
O. B. Firsov 8 Apr. 1964 18 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 21, no. 5, 1951 p 627–633; Dokl. Akad. Nauk SSSR (Moscow), v. 69, no. 3, 1949 p 357–359
(AID-T-64-18; AD-435013) OTS: $1.60 ph

The effect of a foreign gas on the displacement of lines in the absorption spectrum of atoms near the limit of the series is examined. It is essential that in this case a significant number of molecules are found inside the orbit of the excited electron. The magnitude of the displacement of the appropriate lines is derived as a function of the configuration of the molecules of the foreign gas. The width of energy levels of an atom with a high principal quantum number is interpreted as the result of fluctuations in the density of the gas contained in the electron orbit. Author

N64-28090 Emmanuel Coll., Boston, Mass. Research Language Center
THE EFFECT OF MAXIMUM OPTICAL PATH DIFFERENCE AND BACKGROUND NOISE ON INTERFEROMETRIC SPECTROSCOPY [EINFLUSS DER MAXIMALEN OPTISCHEN WEGLANGENDIFFERENZ UND DES RAUSCHENS IN DER INTERFEROMETRISCHEN SPEKTROSKOPIE]

M. Schubert Bedford, Mass., L. G. Hanscom Field, OAR, Sep. 1963 21 p refs Transl. into ENGLISH from Optik (Stuttgart), v. 18, no. 3, 1961 p 147–156
(Contract AF 19(604)-8505)
(E-T-G-63-22; AD-442290)

The spectrum available at the output of the instrument is an approximation to the true spectrum, and the manner in which the deviations from the ture spectrum depend on the parameters of measurement are given, without any special assumptions concerning the spectrum to be measured. The results are compared with those obtained under equivalent conditions by scanning methods (grating and prism spectrometers). Author

N64-28106 Atomic Energy of Canada Ltd., Chalk River, Ontario
MEASUREMENT OF FISSION NEUTRON FLUXES AND SPECTRA WITH THRESHOLD DETECTORS
J. C. Roy, R. W. Durham, A. G. Fowler, and J. J. Hawton May 1964 36 p refs
(AECL-1994; CRC-1101) Available from Sci. Doc. Distrib. Office, AEC, Chalk River, Ontario: $1.00

The approximate fast flux was determined in several locations within and outside the core of NRX. The reaction rates of a number of activation detectors were measured, and the results were used to indicate how the fast flux spectra deviate from a pure fission spectrum. For one position in the core, lattice position H-18, the measurements were interpreted in terms of a definite equation for the fast-flux energy spectrum. Author

N64-28129 Atomics International, Canoga Park, Calif.
ESCAPE PROBABILITY APPROXIMATIONS IN LUMPED RESONANCE ABSORBERS
John M. Otter 1 Aug. 1964 19 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9744) OTS: $0.50

An approximation to the escape probability throughout a resonance is a lumped resonance absorber is formulated. An effective average chord length that gives a best fit to the exact probability is used in the rational form of Wigner so that the equivalence between homogeneous and heterogeneous cases is maintained. Effective chord lengths are derived for the infinite mass and narrow resonance limits, both including and excluding interference between resonance and potential scattering, in planar, infinite cylindrical, and spherical geometries. Resonance integrals and doppler coefficients for U^{238} calculated by use of various escape probability approximations are compared. Author

N64-28171 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ENGINEERING MAGAZINE Selected Articles
13 Feb. 1964 24 p refs Transl. into ENGLISH from Inzh. Zh., Akad. Nauk SSSR, v. 3, no. 2, 1963 203–206, 322–330
(FTD-MT-63-220; AD-602593)

CONTENTS:

1. THE TRANSITION OF A SPACE VEHICLE, BRAKED IN THE ATMOSPHERE OF A PLANET, INTO THE ORBIT OF AN ARTIFICAL SATELLITE V. A. Il'in p 1–6 refs (See N64-28172 20-29)

2. AXIALLY SYMMETRIC OSCILLATIONS OF CYLINDRICAL SHELLS IN SUPERSONIC FLOW OF GAS K. K. Livanov p 7–21 refs (See N64-28173 20-02)

N64-28201* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
GODDARD SUMMER WORKSHOP PROGRAM IN MEASUREMENT AND SIMULATION OF THE SPACE ENVIRONMENT Final Report, Jun. 18–Sep. 18, 1963
[1963] 302 p refs
(NASA-TM-X-5501[illegible]: X-320-63-264) OTS: $19.75 ph

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1. SOLAR SIMULATION: THEORETICAL CONSIDERATIONS 5 p (See N64-28202 20-28)

2. SPECTROGRAPHIC MEASUREMENTS OF SOLAR SIMULATION SOURCES 30 p (See N64-28203 20-15)

3. THE FILTER-DIFFERENTIAL METHOD FOR SOLAR-SIMULATION SOURCES 12 p. (See N64-28204 20-10)

4. CALIBRATION OF THERMOPILES 11 p refs (See N64-28205 20-15)

5. CALIBRATION OF THE FIVE-CHANNEL TIROS SATELLITE RADIOMETER E. I. Mohr and F. J. Owens 14 p refs (See N64-28206 20-15)

6. CRYOSORPTION G. H. Beyer 7 p refs (See N64-28207 20-23)

7. VACUUM GAUGE SYSTEMS 12 p refs (See N64-28208 20-15)

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N64-28207* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CRYOSORPTION
G. H. Beyer *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 7 p refs (See N64-28201 20-23) OTS: $19.75 ph

Factors affecting the practical application of cryosorption are discussed under the following headings: equilibrium data, kinetic data, temperature control, effective adsorbent reuse, and industrial participation. In addition, recommendations are made that are pertinent to the Goddard program for investigating cryosorption. I.v.L.

N64-28213* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FOUR-CIRCULAR-COIL SYSTEM
D. L. Waidelich and M. Speiser *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 7 p refs (See N64-28201 20-23) OTS: $19.75 ph

Computer analyses of various problems of four-circular-coil systems are reported. A program was adapted to calculate the parameters of the Braunbec system to seven or eight significant figures, and the results are tabulated. A case in which the current in the No. 1 coil had a direction opposite to that of the No. 2 coil was analyzed in more detail, and the results are also tabulated. The magnetic-field intensity of the four-circular-coil system was calculated by obtaining expressions for the field intensity of one coil at a time and then by adding the intensities of the four coils together. Total inductance was determined by calculating the self-inductance of each of the four coils and adding to this the mutual inductances between each possible pair of coils. The results are tabulated for three systems: (1) a vertical or Z-axis coil system; (2) a north–south or H-axis coil system; and (3) an east–west or D-axis coil system. The results indicate that the total inductance of such systems is considerable, and that the total mutual inductance is always above 20% of the total inductance of the system. M.P.G.

N64-28214* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FOUR-SQUARE-COIL SYSTEMS
M. Speiser and D. L. Waidelich *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 9 p refs (See N64-28201 20-23) OTS: $19.75 ph

In the production of uniform magnetic fields, it is believed that a system of square coils would have considerable structural advantage over a system of circular coils. A mathematical analysis was made of the four-square-coil system. Equations derived in this analysis were solved by a computer, and resulting parametric data are presented for the following: systems with currents in the same direction and for systems with currents in the opposite direction. In addition, a computer program was developed that would give solutions at the integral turns. The inductances of the systems were calculated; they appeared to be comparable to those for four-circular-coil systems. Field contours indicated that the circumferential variation was present. I.v.L.

N64-28215* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE SIX-CIRCULAR-COIL SYSTEM
M. Speiser and D. L. Waidelich *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 5 p refs (See N64-28201 20-23) OTS: $19.75 ph

A mathematical analysis was made of the six-circular-coil system—a system that could be used to produce a very uniform magnetic field. A computer solution of the system was made, and results indicated a much higher volume of homogeneity than had been expected. I.v.L.

N64-28216* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF FOUR-COIL SYSTEMS OF FINITE COIL-WINDING AREA
George Rinard *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 16 p refs (See N64-28201 20-23) OTS: $19.75 ph

An investigation to determine the dimensions of coil systems necessary to produce uniform magnetic fields is discussed. The field on the axis was found by direct integration over the winding area; this field was then expanded about the origin in a Taylor series. For a four-coil system, the expressions were found that make the first three nonzero terms vanish; homogeneity was then based on the coefficient of the eighth-order (fourth nonzero) term. Using a new method, it was possible to iterate for any desired ampere–turn ratio and ratio of solenoid length. The results of the analysis for circular and square solenoids are presented, along with the mathematical development. P.V.E.

N64-28217* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENERGY AND TIME BETA-RAY SPECTRA OF FISSION PRODUCTS OF U^{235} AND Pu^{239} BY FISSION NEUTRONS
Robert B. Heller *In its* Goddard Summar Workshop Program in Meas. and Simulation of the Space Environ. [1963] 5 p (See N64-28201 20-23) OTS: $19.75 ph

Calculation of the energy–time beta spectra from the fission of uranium and plutonium is discussed. A short outline of the basic concepts used in making the calculations is given. It was found that both one-step and two-step decay transition models yielded results that differed only in magnitude. From this it was concluded that the fission-fragment beta spectrum is not very sensitive to the model of radioactivity decay used. The results that can be generated by the beta energy–time functions can be used as good practical input data for all reactor and explosion problems. P.V.E.

N64-28272 Rochester U., N.Y.
MASS RENORMALIZATION IN QUANTUM FIELD THEORY II
C. R. Hagen 5 Aug. 1964 7 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-49)

The dispersion theoretical approach of Deshpande and Gerstein to renormalization, a concept largely foreign to S-matrix theory, led to a result that has no direct connection with quantum field theory. The (unrenormalized) spin zero Green's function was considered and was found to trivially generalize to an extended Zachariasen model. R.T.K.

N64-28273 Rochester U., N.Y.
HIGHLY SINGULAR POTENTIAL AND PERATIZATION
H. H. Aly, Riazuddin, and A. H. Zimerman 4 Aug. 1964 10 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-51)

A series of papers have been published recently that discuss the behavior of both wave function and phase shift in the radial Schrödinger equation for highly singular repulsive potentials.

This report considers a potential that is more singular than those potentials previously considered. It is a highly singular repulsive potential of the form

$$V = g\frac{e^{2/x}}{x^4} + g^1\frac{1}{x^4} = g\frac{e^{2/x} + \nu_1^2}{x^4} .$$

where $g\nu_1^2 = g^1$. The Schrödinger equation for zero energy and the S-wave is then

$$\frac{\partial^2\psi}{\partial x^2} - g\frac{e^{2/x} + \nu_1^2}{x^4}\psi = 0.$$

It is shown that in the case of the potential given above that the peratization technique gives the correct answer. I.v.L.

N64-28274 Naval Research Lab., Washington, D.C. Radiation Div.

THE PROPAGATORS OF QUANTUM FIELD THEORIES AS GREEN'S FUNCTIONS FOR BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS

J. N. Hayes 15 May 1964 51 p refs

(NRL-6028; AD-601334)

The material presented is taken from lectures given by the author in an informal seminar on quantum field theories. The purpose of these lectures was to present a calculation of the propagators, or Green's functions, of the different types that appear in quantum field theories within the framework of the theory of boundary value problems for linear partial differential equations, thereby rendering the Green's functions more amenable to physical interpretation. Further, a classical setting of the propagators separates neatly those properties of the propagators that may be discussed without recourse to the procedures of second quantization from those properties that do require the latter methods. Author

N64-28275 Carnegie Inst. of Tech., Pittsburgh, Pa.

MOSSBAUER QUADRUPOLE RESONANCE IN Fe^{57} SINGLE CRYSTALS Technical Report No. 4

Peter S. Zory, Jr. May 1964 78 p refs

(Contract Nonr-760(20))

(AR-4; AD-601202)

If a compound containing Fe^{57} exhibits a two-line Mössbauer absorption spectrum, as is the case for most paramagnetic ferrous salts, then this spectrum may usually be attributed to the electrostatic interaction between an electric field gradient (EFG) and the quadrupole moment of the first excited state of the Fe^{57}. Since the EFG may be represented as a traceless, symmetric tensor of the second rank, it is completely specified by five independent parameters. If the absorber is a single crystal, the two absorption peaks will generally have different intensities, the ratio of the intensities depending upon the orientation of the incident, unpolarized radiation relative to the crystal axes. In this work, a general method is developed that utilizes this intensity ratio to determine the five parameters of the EFG. The method is applied to $FeCl_2 \cdot 4H_2O$, and the measured EFG parameters are utilized to approximately determine the crystalline ground-state wave function of the ferrous ion in this salt. Author

N64-28284 Atomic Energy Commission, Washington, D.C. Div. of Technical Information

PROCEEDINGS OF THE TASHKENT CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY. VOLUME I

S. V. Starodubtsev, ed. Jul. 1964 559 p refs Transl. into ENGLISH of Tr. Tashkentsk. Konf. po Mirnomu Izpol'z. At. Energii, v. 1, 1961 411 p Taskkent, Publ. House of The Acad. Sci. Uzbek SSR

(AEC-TR-6398, Vol. I) OTS: $6.50

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64. RADIATION-ELECTROCHEMICAL PROCESSES IN AQUEOUS SOLUTIONS OF ELECTROLYTES Ts. I. Zalkind, N. B. Miller, G. Z. Gochaliev, and V. I. Veselovskii (Sci. Res. Phys. Chem. Inst. im. L. Ya. Karpov) p 462–471 refs

65. INVESTIGATION OF CERTAIN RADIOCHEMICAL PROCESSES IN AQUEOUS SOLUTIONS AT RELATIVELY HIGH DOSE RATES A. K. Pikaev and P. Ya. Glazunov (Inst. Phys. Chem., Acad. Sci. USSR) p 472–480 refs

66. THE EFFECTS OF A FLUX OF FAST ELECTRONS ON AQUEOUS SOLUTIONS OF SILVER COMPOUNDS G. G. Ryabchikova, V. I. Duzhenkov, and P. Ya. Glazunov (Inst. of Phys. Chem., Acad. Sci. USSR) p 481–485 refs

67. ELECTRON PARAMAGNETIC RESONANCE SPECTRA AND THE KINETICS OF THE ACCUMULATION OF THE PRODUCTS FORMED IN THE RADIOLYSIS OF FROZEN AQUEOUS SOLUTIONS OF SODIUM NITRATE B. A. Sharpatnyi and Yu. N. Molin (Sci. Res. Phys. Inst. im. L. Ya. Karpov) p 486–494 refs

68. HETEROGENEOUS SENSITIZATION OF RADIOCHEMICAL PROCESSES ON A SEMICONDUCTOR-SOLUTION BOUNDARY D. M. Shub, G. S. Tyurikov, and V. I. Veselovskii (Sci. Res. Phys. Chem. Inst. im. L. Ya. Karpov) p 495–504 refs

69. DISSOCIATION OF LARGE MOLECULES DURING ELECTRON IMPACT M. V. Gur'ev, M. V. Tikhomirov, and N. N. Tunitskii (Sci. Res. Phys. Chem. Inst. im. L. Ya. Karpov) p 505–511 refs

70. INCREASING THE HEAT RESISTANCE OF WIRES WITH POLYETHYLENE INSULATION BY THEIR IRRADIATION WITH IONIZING RADIATIONS V. L. Karpov, Yu. M. Malinskii, L. V. Mitrofanova, S. T. Sinitsyn, E. F. Finkel et al. (State Sci. Res. Inst. of the Cable Industry) p 512–520 refs

71. A STUDY OF THE INFLUENCE OF IONIZING RADIATIONS ON THE MOISTURE PERMEABILITY OF POLYETHYLENE D. S. Parfenova, Z. F. Sokolova, E. E. Finkel, and K. V. Chmutov (Sci. Res. Inst. of the Cable Industry) p 521–528 refs

72. ON THE IONIC MECHANISM OF POLYMERIZATION UNDER THE ACTION OF NUCLEAR RADIATIONS A. P. Sheinker and A. D. Abkin (Sci. Res. Phys. Chem. Inst. im. L. Ya. Karpov) p 529–537 refs

73. EFFECTS OF IONIZING RADIATIONS ON THE PROPERTIES OF WOOD AND ITS COMPONENTS A. S. Freidin, Yu. M. Malinskii, and V. L. Karpov (Sci. Res. Phys. Chem. Inst. im. L. Ya. Karpov) p 538–546

N64-28302* Chicago U., Ill.

SPUTTERING OF METEORITES BY He^+, Ne^+ AND A^+ IONS

Dieter Heymann (Found. for Fundamental Res. on Matter) Repr. from J. Geophys. Res., v. 69, no. 9, 1 May 1964 p 1941-1943 refs

(Grant NsG-366)

Some measurements are given on the erosion of meteorites by He^+ and Ne^+ ions. The experiments were performed in an isotope separator. The He^+ sputtering coefficient for the Canyon Diablo meteorite was measured by irradiation with slow neutrons. The irradiated target was mounted inside a glass sphere at an angle of 45° to the separator ion beam, which entered the sphere through a circular hole. The sputtered material was deposited on the inside of the sphere. A small fraction (< 10 percent) was lost through the entry hole. The sputtered material was dissolved in acid containing cobalt, iron, and nickel carriers. The cobalt was isolated with an anion-exchange resin and electroplated on platinum disks, and the Co^{60} activity was measured in a proportional counter of low background. Author

N64-28322* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ATMOSPHERIC ACOUSTICS AS A FACTOR IN SATURN STATIC TESTING
Richard N. Tedrick Washington, NASA, Jul. 1964 142 p refs (NASA-TN-D-2351) OTS: $2.75

The engine noise resulting from the static testing of large space vehicles such as the Saturn S-I is both large in output power level and low in frequency. These characteristics combine to enable the noise to propagate for extremely long ranges. Under some meteorological conditions this energy may be focused by the atmosphere into relatively small areas on the earth's surface. To avoid the problems associated with such focal areas, a program of selective firings has been instituted that is based upon acoustic and atmospheric soundings for the 36 hours prior to the test. The atmospheric and acoustic sounding data are interpreted in the light of the forecasts to anticipate the treads that will govern the meteorological conditions. These findings are then relayed to the responsible project officer who decides whether to fire or reschedule the test. Acoustic measurements are made during the firing to verify the predicted sound pressure levels. Author

N64-28335* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TABLES OF X-COEFFICIENTS AND Λ-FACTORS FOR TRIPLE ANGULAR CORRELATION ANALYSIS
Jag J. Singh and Chris Gross Washington, NASA, Sep. 1964 71 p refs
(NASA-TN-D-2454) OTS: $1.75

The Fano X-functions[2] X(abc,def,ghk) and the Λ_{ghk} angular functions are useful for the analysis of triple correlation measurements in nuclear reaction studies. The tables in this report give these coefficients as a function of the various parameters. The parameters a and d are restricted to integral values up to 3; b, c, e, and f can take either all half-integrals or all integral values up to 5, whereas g, h, and k are restricted to even integral values up to 8. Author

N64-28343 Joint Publications Research Service, Washington, D.C.
PROBLEMS IN STOCHASTIC SYSTEMS AND OPTIMUM CONTROL
12 Aug. 1964 25 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, No. 2, 1964
(JPRS-25874; TT-64-41145) OTS: $1.00

CONTENTS:
1. STABILITY ON THE WHOLE OF STOCHASTIC SYSTEMS—I. Ya. Kats p 1–11 refs (See N64-28344 20-23)
2. REDUCTION OF ONE CLASS OF OPTIMUM CONTROL PROBLEMS TO THE SIMPLEST VARIATIONAL PROBLEM TO THE SIMPLEST VARIATIONAL PROBLEM G. N. Mil'shteyn p 12–22 refs (See N64-28345 20-25)

N64-28344 Joint Publications Research Service, Washington, D.C.
STABILITY ON THE WHOLE OF STOCHASTIC SYSTEMS
I. Ya. Kats *In its* Prob. in Stochastic Systems and Optimum Control 12 Aug. 1964 p 1–11 refs (See N64-28343 20-23) OTS: $1.00

The problem of stability with probability in the whole of stochastic systems of differential equations is considered. The criterion of stability is constructed by the application of the two functions of Lyapunov. A theorem is proved for stochastic systems that is an analog of that proved for ordinary differential equations. I.v.L.

N64-28345 Joint Publications Research Service, Washington, D.C.
REDUCTION OF ONE CLASS OF OPTIMUM CONTROL PROBLEMS TO THE SIMPLEST VARIATIONAL PROBLEM
G. N. Mil'shteyn *In its* Prob. in Stochastic Systems and Optimum Control 12 Aug. 1964 p 12–22 refs (See N64-28343 20-23) OTS: $1.00

The task of minimizing the functional $J = \int f_0(x)\,dt$ (1.0) is considered. Here $x = (x_1(t), \ldots, x_n(t)$ is an n-dimensional vector whose change in time obeys the system of differential equation recorded in the vector form $dx/dt = f(x,u)$ (1.2). Control u is an r-dimensional vector, the value of which at any time belongs to a certain set U from an r-dimensional Euclidean space. Set U is assigned with the aid of the inequality $\rho(u_1, \ldots, u_r) \leq m$, where $\rho(u_1, \ldots, u_r)$ is a continuous differentiable function. Function $f_0(x)$ in (1.1) is considered positive throughout, excluding the point $x = 0$. The circuit of the greater part of optimum control problems is constructed so that the second point is usually fixed, while the first occupies an arbitrary position. Subsequently, the first point is fixed (to define the origin of the coordinates), while the second is chosen arbitrarily. In order to bring the problem considered into the form of the above without changing the movement of time, it is sufficient to substitute (1.2) and (1.1), respectively, by $dx/dt = -f(x,u)$, $J = \int_{t_1}^{t} f_0(x)\,dt$. I.v.L.

N64-28416 Army Missile Command, Huntsville, Ala. Reentry Physics Branch
AN APPROXIMATE METHOD FOR PREDICTING THE RADIATION FROM PURE EQUILIBRIUM AIR Technical Note NO. 3
T. Roy Bowen 8 Apr. 1964 83 p refs
(Sponsored by ARPA; Proj. Defender)
(TN-AMSMI-RNR-63-3; AD-442216)

A study of the predicted emission of visible radiation from shock-heated air was undertaken to compare the estimates from different sources, in order to establish a confidence level for these estimates. The predictions of Keck, et al., and Meyerott, et al., were chosen and converted to terms of total spectral radiant intensity as a common basis for comparison; the agreement between the two methods was quite good at the common points. In addition, a simple empirical relationship was selected that permits a rapid approximate evaluation of the equilibrium gaseous radiation from a flow field in a form suitable for programing on a digital computer. To date, this program has been used to predict the gaseous radiation from ballistic range pellets and other subscale ballistic projectiles with encouraging agreement with experiment. This program should not be used to extrapolate outside the range of temperatures for which it was developed ($3{,}000° K \leq T \leq 12{,}000° K$). M.P.G.

N64-28434 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 106
28 Aug. 1964 51 p refs Transl. into ENGLISH of 4 articles from K'O-Hsueh T'ung-Pao (Peking), No. 6, Jun. 1964
(JPRS-26193; TT-64-41452) OTS: $3.00

CONTENTS:
1. PROBLEM OF ADHESION Wu Shih-k'ang, Chou I-ch'in and Chang Hsien p 1–25 refs

2. THE MECHANISM OF ICE-FORMING NUCLEI AND ARTIFICIAL SUPERCOOLED CLOUD AND FOG Chao Pai-lin p 25-36 refs

3. DYAMICS OF CATALYTIC CHROMATOGRAM. I. PROBLEMS ON THE HALF REGIONAL WIDTH AND THE RETAINING TIME OF THE REACTANT AND REACTION PRODUCT DURING THE LINEAR EQUILIBRIUM CHROMATOGRAM Chang Su, Lou Na-ch'uan, and Chang Ta-yu p 37-44 refs

4. CRYSTAL STRUCTURE OF $C\mu$ $(NH_3)_2(SCN)_2$ Huang Chin-lin and Ch'en Yuan-chu p 45-49 refs

N64-28461* Radio Corp. of America, Princeton, N.J. Special Electronics Components Div.

THE FEASIBILITY OF BUILDING A 150-KILOGAUSS, LARGE VOLUME SUPERCONDUCTIVE MAGNET WITH VAPOR-DEPOSITED Nb_3Sn RIBBON Final Report

N. S. Freedman, E. R. Schrader, F. Kolondra, F. R. Nyman, H. C. Schindler et al 24 Jul. 1964 86 p refs

(Contract NAS3-2520)

(NASA-CR-54061) OTS: $8.10ph

Extensive testing of RCA vapor-deposited Nb_3Sn ribbon in the form of short samples and coils showed that an inherent low magnetic field instability of this high-current-density superconductor is a major cause of solenoid degradation. The factors affecting these instabilities at all stages from the initial deposition of the Nb_3Sn on the substrate to the final winding and testing of a coil are indicated. The practical result of this work is shown in the form of a 92-kilogauss, 1/2-in.-bore vapor-deposited Nb_3Sn ribbon magnet. Practical considerations involving encapsulation of coils, superconducting-to-normal contacts, and ribbon plating parameters are treated. The design and construction of large-bore, high-field superconductive magnets is feasible using the RCA vapor-deposited Nb_3Sn ribbon. Author

N64-28511 Rochester U., N.Y.

MEASUREMENT OF THE TRIPLE SCATTERING PARAMETER R' AT 213 MEV

Kazuo Gotow and Frederick Lobkowicz 24 Jul. 1964 14 p refs Submitted for Publication

(Contract AT(30-1)-875)

(UR-875-48)

In a continuation of the study of the nucleon-nucleon interaction, a combination of the triple scattering parameters R and R' in proton-proton scattering at 213 Mev was measured in the angular range 30° to 90° c.m. Using an earlier measurement of R, values of R' were obtained. The data are compared to predictions given by the Hamada-Johnston potential model and by a modified phase shift analysis using all previously measured data. Author

N64-28515 California U., Riverside

BEHAVIOR OF SOLIDS UNDER PRESSURE Annual Progress Report

A. W. Lawson Jul. 1964 51 p refs

(Contract Nonr-1842(05))

(AD-602044)

The electrical conductivity of Ag_2HgI_4 is primarily ionic above the order-disorder transition temperature of 50° C. Below this critical temperature, there is an appreciable electronic component. The effect of pressure, at all temperatures, is initially to increase the conductivity. However, the conductivity passes through a maximum and decreases between 4,000 kg/cm^2 and 6,000 kg/cm^2. This unusual pressure behavior is not explicable in terms of any simple model. A new phase, which is presumably an analog of that occurring in AgI, appears above about 6,000 kg/cm^2. The conductivity in this phase is primarily electronic, even at high temperatures. Author

N64-28529 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

TREATISE ON THE CHROMATIC POLARIZATION PRODUCED BY COMPRESSED GLASS

M. G. Wertheim 24 Jul. 1964 7 p Transl. into ENGLISH from Comt. Rend. Acad. Sci. (Paris), v. 32, 1950 p 289-292

(RSIC-231; AD-604332)

Investigations were conducted to determine whether various homogeneous bodies would acquire the same birefringence, or different birefringence, if identical compression and expansions could be produced in these bodies. The contraction taking place in the direction of compression and the expansion in the direction perpendicular to it, as well as the resulting double refraction, were determined for crown glass, mirror glass, and flint. Results showed that the specific birefringence is the same for crown glass, mirror glass, and flint, in spite of the differences in composition and specific weights. These glasses must therefore undergo the same linear compression to give them the same absolute birefringence. In addition, the simultaneous action of compression and magnetization in crystals of spar, quartz, and beryl was investigated. Results indicate that magnetic rotation disappears as the pressure is increased. I.v.L.

N64-28531 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

A PRACTICAL METHOD FOR INVESTIGATING AND MEASURING THE BIREFRINGENCE OF OPTICAL GLASS

H.-L. Tardy 28 Jul. 1964 15 p refs Transl. into ENGLISH from Rev. d'Optique (Paris), V. 8, 1929 p 59-69

(RSIC-236; AD-604330)

A practical method for studying the annealing of optical glass should make it possible to survey at one glance the general distribution of the birefringence; to determine quickly (in a few seconds) the value of the birefringence in arbitrarily selected points; and to trace the contour lines of the birefringence on the glass under examination. A method is presented that satisfies these conditions, and a suitable instrumental arrangement is described. An example of an application is given. Author

N64-28557 Oklahoma U., Norman

AN EXPERIMENTAL STUDY OF INFRA-RED SCATTERING BY CLOUDS OF PARTICLES

T. J. Love and R. A. Wheasler Jun. 1964 167 p refs

(Contract AF 33(657)-8859)

(ARL-64-109; AD-603851) OTS: $3.00

This report describes a study of the extinction and scattering of infrared radiation from an aerosol of fine particles. A description is given of the method developed for generation of a uniform optically thin cloud of particles. Reynolds aluminum 40XD powder was used for this test. The optical equipment including glo-bar source, focusing optics, traversing mechanism, and Perkin Elmer model 98 monochromator is described. The extinction coefficient and normalized scattering function is reported for 21 wavelengths of incident radiation. Author

N64-28567 Martin Co., Baltimore, Md. Research Inst. for Advanced Studies
STUDY OF CESIUM ON REFRACTORY METALS USING FIELD EMISSION MICROSCOPY Final Report
James L. Gumnick, Gerald J. Daly, and J. Scott Hildum Apr. 1964 82 p refs
(Contract AF 19(628)-2831)
(AFCRL-64-328; AD-603902)

This program was initiated to ascertain the cause of the cyclic and spontaneous migrations of cesium on refractory metals. Data supporting the hypothesis that the spontaneous migration is the result of lattice heating by emission of electrons of less than Fermi energy have been obtained. Calculations of the activation energy for cesium migration on a cesium substrate using these data are in agreement with results of other workers. The spontaneous migration was very similar for different emitter types and appeared to be almost the same for all substrates. Variations in rates of migration were dependent upon applied field, but not on environmental pressure or temperature. Author

N64-28568 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
TRANSVERSE FOCAL REGION OF A SHPERICAL REFLECTOR. PART I: GEOMETRIC OPTICS Scientific Report No. 1
Roy C. Spencer and Geoffrey Hyde Mar. 1964 55 p refs
(Contract AF 19(628)-2758)
(AFCRL-64-292; AD-603788)

The concepts of geometric optics as applied to a spherical reflector are discussed in detail. The caustic surface of a spherical reflector is examined, with particular emphasis on the advantages of complex number notation, and representation in terms of the height of the incoming ray and the arc length along the caustic. The focal region within the caustic curves is studied, and the importance of the circle of least confusion is pointed out. The use of wavefront constructions as an alternate approach is illustrated. The functional relationships are developed for the path length to a field point on a concentric surface in the focal region, its spherical coordinates, and the height of incoming rays. Computations are summarized on graphs. The relationship between stationary phase and path length is mentioned. Author

N64-28578 ARO, Inc., Arnold Air Force Station, Tenn.
CROPUMPING CAPTURE COEFFICIENTS OF TWO NITROGEN-OXYGEN GAS MIXTURES
J. D. Dawson Arnold Eng. Develop. Center, Aug. 1964 30 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-150; AD-603623)

The experimental investigation of two nitrogen–oxygen mixtures is presented, and the results are interpreted by the critical velocity model. A direct comparison of the capture coefficients calculated from this model is made with the actual capture coefficients, assuming that the gases behave ideally. Author

N64-28641 European Organization for Nuclear Research, Geneva (Switzerland) Div. d'Etudes Theoriques
METHODS FOR DETERMINATION OF SPIN AND EQUALITY OF RESONANCES [METHODES POUR LA DETERMINATION DU SPIN ET DE LA PARITE DES RESONANCES]
Mary K. Gaillard 8 Jul. 1964 54 p refs
(CERN-64-33)

Investigations of strong interactions have revealed a number of resonant states among elementary particles. A knowledge of the quantum number of these states (oddness, isotropic spin, and intrinsic parity) is essential to relate them to the present theories of strong interactions, such as the symmetry of the group or poles of Regge. A determination of spin and parity depends on the complex manner of the angular distributions in the production of these states and in their disintegrations. Included in this report are the following: (1) the construction of a density matrix from the normal states of the operator of S-spin, defined in a system where the particle is at rest; (2) existing methods for determining the spins and parities in strong interactions, with emphasis on resonant states of nonzero oddness; (3) the use of a polarized target for obtaining information essential to the study of angular correlations; and (4) the use of a polarized target for determining the spin and parity of resonances. I.v.L.

N64-28655 Chalmers U. of Tech., Goteborg (Sweden)
THE BACKSCATTERING OF FAST NEUTRONS FROM PLANE AND SPHERICAL REFLECTORS
Martin Leimdorfer Goteborg, Scandinavian U. Books, 1964 31 p refs *Its* Trans. No. 288 Scandinavian U. Books: 8 Sw Kr.

The Monte Carlo method has been used for a study of neutron backscattering from plane and concave spherical reflectors of hydrogen, water, concrete, aluminum, iron, and uranium. A calculation technique, which was initially designed to be efficient for deep penetration calculations, is applied with only a simple alteration, reversing the bias to promote the migration of neutrons back toward the source. Author

N64-28656 European Organization for Nuclear Research, Geneva (Switzerland)
DESIGN AND CONSTRUCTION OF QUADRUPOLE LENSES WITH LARGE ELLIPTICAL APERTURE
M. Morpurgo 9 Jul. 1964 17 p
(CERN-64-34)

Quadrupole lenses with large apertures are useful in the focusing of high-intensity particle beams from an accelerator. This report gives the mathematical design of a quadrupole lens with an elliptical aperture and describes its construction. One of the most difficult construction problems is the winding of the coils. This problem was solved by dividing each of the four lens coils into into four windings. The field gradient constancy of the lens is better than $\pm 0.5\%$. The main features of the lens are summarized in tabular form. I.v.L.

N64-28668 Atomics International, Canoga Park, Calif.
AIROS: A DIGITAL SIMULATOR FOR POWER REACTOR DYNAMICS
R. A. Blaine and R. F. Berland 1 Aug. 1964 123 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9943) OTS: $2.50

The AIROS is a digital simulator for power reactor dynamics. It solves the space independent reactor kinetics equations and provides for the determination of reactivity by solving, in addition, the discretized equations that represent the spatial heat and mass-transfer model for several fuel channels. Also, the variation of the film coefficient with flow is accounted for along with the provision for flow decay and afterglow heating. SCRAMS can be initiated by delayed signals from instruments that sense any quantity calculated, e.g., power, inverse period, or temperature. The AIROS, which is written in FORTRAN, is built of small modules or subroutines so that future modifications or additions can be made as better physical

models are available. The numerical method involved is that developed by E. R. Cohen. It is, essentially, a fifth-order method with automatic time-step variation to insure the required accuracy with the minimum expenditure of computer time. Special provisions are made for startup problems, resulting in 60% reduction in running time over conventional codes. I.v.L.

N64-28672 Hartford U., Conn. Research Inst.
THE TRANSMISSION OF SOUND IN A MOVING FLUID
Charles T. Dwight [1964] 35 p
(Contract Nonr-185-802)
(Rept.-2; AD-601526)

The current program status includes these efforts: (1) The development of a measuring technique to determine the performance of acoustic elements in moving streams of water has been accomplished to at least a first order of magnitude. The technique developed indicates, as illustrated in the body of this report, that a signal can be introduced at one end of a simulated piping system, and that its output can be analyzed to demonstrate the type of element present in the system as well as its acoustic performance under both flow and no-flow conditions. (2) The training of undergraduate mechanical and electrical engineers in the problems of acoustics, as associated with moving fluids, is progressing. I.v.L.

N64-28677 Adelaide U. (Australia)
VACUUM ULTRA-VIOLET ION CHAMBERS
J. H. Carver and P. Mitchell [1963] 10 p refs
(Partially Sponsored by Austral. Dept. of Supply)

The characteristics of a number of selective ultraviolet ion chambers of the Friedman type are described. Ethyl chloride, ethyl bromide, carbon disulphide, acetone, ethyl iodide, nitric oxide, benzene, toluene, p-xylene, and mesitylene were used as filling gases to limit the response of the chambers on the long wavelength side. Windows of lithium fluoride, calcium fluoride, barium fluoride, and sapphire provide the short wavelength cutoffs. The spectral response curves and quantum efficiencies of these chambers were determined and photoabsorption coefficients were measured for a number of the filling gases. Author

N64-28699 California U., Berkeley Lawrence Radiation Lab.
ENERGY-DEPENDENT PION-NUCLEON PHASE SHIFT ANALYSIS 0-700 Mev l_m = 4 SOLUTION
L. David Roper and Robert M. Wright 4 Jun. 1964 90 p refs
(Contract W-7405-ENG-48)
(UCRL-7846) OTS: $2.00

The equations used in an energy-dependent pion-nucleon phase shift analysis are listed. A list of pion-nucleon scattering data references is included. The best solution obtained using $l_m = 4$ for a selected set of 0-700-Mev data is given, and graphical comparisons between the solution and the data are given. This solution's predictions for observables that were not yet measured are given. There are three resonances in this solution—P_{33} at 193 Mev laboratory kinetic energy (mass = 1234 Mev); P_{11} at 575 Mev (mass = 1497 Mev); and D_{13} at 638 Mev (mass = 1,534 Mev). Author

N64-28709 Atomic Intrnational, Canoga Park, Calif.
MATERIAL BUCKLINGS OF CRITICAL AND SUBCRITICAL URANIUM CARBIDE FUELED GRAPHITE ASSEMBLIES. PART II: THEORETICAL INTERPRETATION
E. R. Specht 1 Aug. 1964 49 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9772) OTS: $1.00

Material bucklings for uranium carbide fuel elements, enriched to 3.02 wt % of uranium 235, were obtained from critical and subcritical assemblies. The fuel elements were placed in a graphite assembly on triangular lattice pitches of 9, 11, and 12 inches. Four-group theory was used to infer material bucklings from 12 two-region critical mass measurements. Material bucklings were obtained from 22 subcritical assemblies consisting of 31, 23, and 19 cells set at pitches of 9, 11, and 12 inches. The large differences observed (up to $3.4 m^{-2}$) between the critical and uncorrected subcritical values of B_m^2 were due to diffusion anisotropy and the use of calculated, rather than measured, radial bucklings in the subcritical experiments. Multigroup (15 energy group) cell calculations gave material bucklings that agreed very well with those inferred from the critical assemblies. Author

N64-28715 American Meteorological Society, Boston, Mass.
THE EFFECT OF ABERRATIONS ON THE OPTICAL TRANSFER FUNCTION FOR LOW SPATIAL FREQUENCIES [DER EINFLUSS DER ABERRATIONEN AUF DIE OPTISCHE UBERTRAGUNGSFUNKTION BEI KLEINEN ORTS-FREQUENZEN]
W. Lukosz Bedford, Mass., AFCRL Dec. 1963 32 p refs
Transl. into ENGLISH from Optica Acta (Paris), v. 10, 1963 p 1–19
(Contract AF 19(604)-6113)
(T-G-200+; AD-442341)

The effect of aberrations on the transfer function of optical systems working with incoherent illumination is investigated theoretically for the case of low spatial frequencies. At these frequencies, the decrease of the modulation transfer function is proportional to Gauss's moment (the second-order moment of the geometric optical intensity distribution of the point source image). Relations between the geometric optical transfer function and the azimuth are derived. For systems with rotational symmetry and circular exit pupil, the contributions of the different terms (or single aberrations) of the total aberration function are calculated. By virtue of the orthogonality of the trigonometric functions and of the circle polynomials, the calculation of Gauss's moments is considerably simplified. The new expansion of the aberration function has a marked advantage in connection with the balancing of aberrations of different types and orders for obtaining optimum transfer for low spatial frequencies. I.v.L.

N64-28719 Weapons Research Establishment (Australia) Dept. of Supply
THE PARABOLOIDAL AERIAL WITH A COSINE PRIMARY FEED
H. E. Green Feb. 1963 14 p refs
(WRE-TN-EID-62)

This paper presents a treatment of the paraboloidal reflector illuminated with a $\cos^n$ primary feed by numerical methods suitable for programing on an IBM 7090 computer. More extensive results than seem to have previously appeared in the literature are given to provide complete design data for this type of aerial. The accuracy of the numerical approach is tested by using it to solve the problem of a uniformly illuminated circular aperture, which can also be attacked analytically, and by comparing the results. No significant inaccuracies are observed to be generated. Author

N64-28726 Argonne National Lab., Ill.
PHYSICS DIVISION SUMMARY REPORT Annual Review, 1 Apr. 1963–31 Mar. 1964

[1964] 157 p refs
(Contract W-31-109-ENG-38)
(ANL-6879) OTS: $2.75

The current status of a program aimed at a more complete understanding of the atomic nucleus includes the following areas: (1) neutron and neutron-induced reactions at the reactor CP-5; (2) neutron and charged-particle-induced reactions at the 4.5-Mev Van de Graaff accelerator; (3) charged-particle reactions at the tandem Van de Graaff accelerator; (4) charged-particle reactions at the 60-in cyclotron; (5) various experiments that use the Mössbauer effect; (6) atomic beam studies; (7) studies of the decay of short-lived radionuclides; (8) theoretical physics with emphasis on the automated shell-model program, using the CDC-3600 computer; and (9) extranuclear properties of matter with emphasis on mass spectrometric studies, plus a modest effort in plasma physics that is concerned mainly with the properties of RF plasmas and the containment of plasmas in RF cavity fields. I.v.L.

N64-28742* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LYMAN-α RESONANT SCATTERING USING RANDOM STOKES VECTORS
S. O. Kastner Jun. 1964 14 p refs
(NASA-TM-X-55062; X-614-64-165) OTS: $1.60 ph

The case of relatively few scatterings of Lyman-α resonance radiation in a uniform hydrogen gas is treated by using Stokes vectors as random variables in a Monte Carlo type of calculation. Doppler redistribution of frequencies and the doublet nature of the line are taken into account. Author

N64-28760* Hughes Research Labs., Malibu, Calif.
INVESTIGATION OF RF, NOISE GENERATION FROM SPACE VEHICLES Final Report, 24 Jun. 1961–24 Dec. 1962
R. D. Wanselow and H. L. Wiser [1962] 39 p refs
(Contract NAS8-862)
(NASA-CR-58489)

Initial effort was devoted to analytical determination of noise generated in neutralized ion beams by various mechanisms. Operating parameters of the plasma engine that affect RF noise were determined, and suitable typical values of these parameters were selected for quantitative calculations. Experimental investigations were made on a typical annular ring cesium contact ion engine over the communications frequency spectrum. The tests yielded no measurable noise output from the ion beam itself, although RF radiation as a result of low level periodic arcing across engine insulators was observed early in the program. However, an improved engine design eliminated this source of radiation. Measurements also were made on the Penning discharge engine, the tests indicating that this type of engine will generate RF noise interference for space communications receivers. Author

N64-28786 Oak Ridge National Lab., Tenn. Neutron Physics Div.
THE NUCLEON TRANSPORT CODE, NTC
W. E. Kinney Aug. 1964 102 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(ORNL-3610) OTS: $2.25

Detailed information concerning the interactions of high-energy (about 400 Mev) nucleons with matter is of particular interest in the design of radiation shields for space vehicles and high-energy particle accelerators. The Monte Carlo method was applied to the calculation of such interactions in the construction of the Nucleon Transport Code (NTC), a linked series of newly written codes for treatment of high-energy transport and previously written codes for the treatment of neutrons of energies below 50 Mev. NTC, written for the IBM 7090 computer, calculates the transport of nucleons having initial energies as high as 400 Mev through complex arbitrary configurations containing a maximum of four media, each of which may be composed of up to 10 isotopes. Cascade processes and particle evaporation from excited nuclei are taken into account. The end result of NTC is one or more magnetic tapes containing the detailed records of all quantities pertinent to the transport of the nucleon. These tapes can be independently analyzed by the individual user of NTC to produce desired solutions to specific problems. Author

N64-28798 American Meteorological Society, Boston, Mass.
CONFIGURATION INTERACTION IN ATOMIC SPECIES OF BERYLLIUM TYPE [VZAIMODEISTVIE KONFIGURATSII V ATOMAKH TIPA BERILLIA]
A. P. Iutsis and V. I. Kavetskis Bedford, Mass., AFCRL, Aug. 1963 14 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 21, no. 10, 1951 p 1139–1145
(Contract AF 19(604)-6113)
(T-R-405^{+}; AD-602147)

The effect of configuration interaction on the energy of the ground configuration of the isoelectronic series Li^{-}, Be, B^{+}, C^{+2}, N^{+3}, and O^{+4} was calculated, and the calculated energies were compared with experimental data. The stability of negative ions of alkali metals is examined. Author

N64-28801 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
NOISE ANALYSIS IN NUCLEAR SYSTEMS
Robert E. Uhrig, coordinator (Florida U.) Jun. 1964 513 p refs Proc. of a Symp. held at Florida U., Gainesville, 4–6 Nov. 1963; (Sponsored by AEC and Florida U.)
(TID-7679) OTS: $3.75

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13. CROSS POWER SPECTRAL MEASUREMENTS IN THE TWO-CORE UNIVERSITY TRAINING REACTOR-10 R. A. Danofsky (Iowa State U.) p 229–250 refs

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19. HARMONIC ANALYSIS OF THE INSTANTANEOUS COUNTING RATE OF A PERIODICALLY SAMPLED FLOW OF PULSES J. Freycenon (Commissariat a l'Energie Atomique, Saclay, France) p 331–334 refs

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23. MINIMIZATION OF REACTOR NOISE THROUGH MINIMUM BANDWIDTH CONTROL L. E. Weaver and H. S. Murray (Arizona U.) p 369–385 refs

24. MEASUREMENT OF NOISE IN THREE PRESSURIZED-WATER REACTORS R. M. Ball and M. L. Batch (Babcock and Wilcox Co.) p 387–403 refs

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27. REACTOR-NOISE EXPERIMENTS ON HALDEN BOILING WATER REACTOR T. Eurola p 449–468 refs

28. NOISE MEASUREMENTS IN THE DOUNREAY FAST REACTOR F. D. Boardman (United Kingdom Atomic Energy Authority) p 469–500 refs

N64-28803 European Organization for Nuclear Research, Geneva (Switzerland)
[NINTH] ANNUAL REPORT, 1963
1964 182 p refs

Research conducted in the following areas is discussed: (1) the structure and scattering of particles of high energy; (2) the new "spectroscopy" of excited quantum states of nucleons and bosons; and (3) the study of weak interaction phenomena. In the studies of the structure and scattering of elementary particles, a number of experiments were performed from which it is hoped to gain a deeper insight into the structure of the nucleon. One among the many experiments is the measurement of the very rare production of electron and muon pairs by proton–antiproton annihilation. Experiments on high-energy scattering of protons and pions by protons led to the observation of an interesting energy dependence of the excitation of isobars by proton-proton collision. Studies of quantum states of nucleons and bosons led to the discovery of new resonances and the establishment of the properties of known states or "particles." Two new bosons were found, and the width of the vector boson was determined. In studies of weak interaction phenomena, CERN succeeded in producing a beam of neutrinos in the Gev energy region, with an intensity of about 10^9 neutrinos every few seconds, concentrated over an area of about one square meter onto two detectors. I.v.L.

N64-28820 RAND Corp., Santa Monica, Calif.
TABLES OF COLUMNAR AIR MASS BETWEEN TWO POINTS IN THE ATMOSPHERE AND IONIZATION PRODUCTION RATES DUE TO DEBRIS-DECAY γ RAYS
E. C. Field, M. Lakatos, and P. Tamarkin Jun. 1964 125 p refs
(RM-4142; AD-602007)

Tables of the mass of air contained in a column of atmosphere of 1-cm^2 cross section and extending between many pairs of points in the terrestrial atmosphere are presented. Such a tabulation is useful, for example, in the study of atomspheric effects due to various types of radiation from nuclear bursts. Extensive tables of ionization production rates at various locations due to γ-rays from restricted regions of decaying fission debris are also given. A variety of source-field point geometries, corresponding to those in the air-mass tables, are used, and three γ-ray energies are considered. Author

N64-28878* Ohio State U. Research Foundation, Columbus
NOMOGRAPHS FOR RELATIVISTIC VELOCITY TRANSFORMATION
Richard J. Plugge and Chen To Tai 25 Jul. 1964 16 p refs
(Grant NsG-448)
(NASA-CR-58494; Rept.-1691-8) OTS: $1.60 ph

Three nomographs are presented, illustrating the transformation of velocities from one inertial reference frame to another that is moving in uniform translation with respect to the first. Author

N64-28879* Catholic U. of America, Washington, D.C.
COLLATZ BOUNDS AND THE COLLOCATION METHOD
J. H. Baltrukonis and Michael Chi Jul. 1964 23 p refs
(Grants NsG-125-61, Suppl. 3)
(NASA-CR-58672; TR-6) OTS: $2.60 ph

A systematic method is devised to obtain precise bounds in special eigenvalue problems. The method has the advantage that only differentiation is involved in the process once suitable trial functions are obtained. Compared with other bounding techniques in which extensive integrations are necessary, this method appears to have the advantage in simplicity. In application the method is ideally suited to the use of large-scale computers. Two illustrative problems are solved in order to demonstrate the capabilities of the technique. Author

N64-28881* Varian Associates, Beverly, Mass.
HYDROGEN MASER PROGRAM Interim Technical Report, 1 Feb. 1962–31 May 1963
R. Vessoi 30 Jan. 1964 82 p refs
(Contract NAS8-2604)
(NASA-CR-58525) OTS: $8.10 ph

The hydrogen maser is the result of a search for a new type of maser operating between two hyperfine levels in one of the hydrogen-like atoms. This report describes the design and development of its various components. These include: (1) the frame and vacuum manifold; (2) the hydrogen purifier and flow control; (3) the magnetic hexapole state selector; (4) the hydrogen storage bulb; (5) the RF cavity; and (6) magnetic shielding and field controls. In addition, data are reported from measurements of the relative stability of two masers as well as on their stability as measured via external communications. I.v.L.

N64-28891* Texas A&M U., College Station Space Technology Div.
INTERDISCIPLINARY SPACE-ORIENTED RESEARCH PROGRAM IN THE PHYSICAL, LIFE, AND ENGINEERING SCIENCES Progress Report, Projects 2 Through 11
Harry E. Whitmore Aug. 1964 200 p refs
(Grant NsG-239-62)
(NASA-CR-58625) OTS: $13.50 ph

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9. MAGNETIC PROPERTIES OF SOLIDS Charles J. Squire, Tom W. Adair, III, R. Zamecki, and E. Sharp p 11-1–11-6 refs

N64-28892* Texas Instruments, Inc., Dallas Apparatus Div.
HANDBOOK OF DEFINITIONS, TERMS, FORMULAS, CONVERSION TABLES, AND MEASUREMENT METHODS FOR MAGNETIC PHENOMENA
Kenneth S. Goldstein and Grant R. Gray 31 Dec. 1963 121 p refs
(Contract PL-BE-4-217626)
(NASA-CR-58591; Rept.-2-610242-2) OTS: $10.10 ph

The origin of magnetic effects is discussed at length, and the inverse-cube relationship, the dipole field, magnetic shielding, magnetization, and demagnetization are included. A large glossary includes a list of symbols and their meanings. The development of different systems of units is explained, and a short table of conversion factors is given. Formulas are given for the computation of various magnetic quantities that are frequently encountered in low magnetic-field measurements and design problems. High field and low field measurement methods are described, various low field methods and devices are explained in detail, and the modified spinner method, testing in a coil system, and testing in a shielded enclosure are discussed at length. Indirect measurement methods are listed. D.E.W.

N64-28904 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
SPECTRAL EMISSIVITIES AND INTEGRATED INTENSITIES OF THE 6.3-μ ν_2-FUNDAMENTAL BAND OF H_2O
C. C. Ferrisco, C. B. Ludwig, and C. N. Abeyta Jul. 1964 36 p refs
(Contract NoNr-3902(00); Proj. Defender)
(GDA-DBE64-046; AD-444420)

Spectral emissivities of the ν_2-fundamental and portions of the rotational bands of water have been measured between 550° and 2,200° K. The hot water vapor samples were produced in a small supersonic burner using H_2 and O_2. The variation of the spectral emissivities of H_2O as a function of temperature was obtained for a constant amount of H_2O in the optical path. An estimate of the integrated intensity of the 6.3μ fundamental band has been made from the high temperature emission spectra. Author

N64-28906 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
NEUTRON CROSS SECTIONS FOR NITROGEN AND OXYGEN
R. L. Kloster and M. B. Wells 31 May 1963 96 p refs
(Contract AF 33657)-7201)
(NARF-62-17T; MR-N-298; AD-417704)

Neutron cross sections for nitrogen and oxygen that are of primary interest in shielding and transport calculations are compiled in this report. Cross sections for the following processes are compiled for both oxygen and nitrogen: total, elastic scattering, nonelastic collisions, inelastic scattering, differential elastic scattering, (n,α) reactions, (n,p) reaction, and (n,d) reaction. The following cross sections are compiled for nitrogen only: gamma-ray production, (n,t) reaction, (n,2n) reaction, and (n,2α) reaction. Cross sections of nitrogen for excitation of the various levels of the residual nucleus in the (n,αj), and (n,n'j) reactions are also compiled. Author

N64-28907 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
ENERGY AND ANGULAR DISTRIBUTION EXPERIMENT. VOLUME II: ANGULAR DISTRIBUTION OF FAST-NEUTRON AND GAMMA-RAY NUMBER-ENERGY FLUX FROM SLABS
G. T. Western 30 Sept. 1963 47 p refs
(Contract AF 33(657)-7201)
(NARF-62-16T; FZK-9-183-2; AD-430102)

An experiment in which a narrow-beam slab geometry was used to project radiation from a shield test reactor onto test materials of 3% borated linear polyethylene and of lead was performed. Except as noted, measurements for polyethylene and lead were made of the radiation source terms; the flux distribution of thermal and fast neutrons within the test materials; the angular distribution of thermal- and epithermal-neutron flux, fast-neutron dose rate, and secondary gamma rays from the test materials; the reflection of neutrons from 3% borated polyethylene and from steel; the angular distribution of fast-neutron number-energy flux; and the angular distribution of gamma-ray dose rate and number-energy flux resulting from primary gamma rays scattered from the test materials. Author

N64-28915 Stanford Research Inst., Menlo Park, Calif.
COUPLED-MODE THEORY FOR ADVANCED MICROWAVE DEVICES Technical Documentary Report, Covering Period Mar. 1962–Mar. 1964

M. C. Pease Wright-Patterson AFB, Ohio. AF Avionics Lab., Aug. 1964 40 p refs
(Contract AF 33(657)-8343)
(AL-TDR-64-177; AD-604423)

The three principal areas of effort include the pairwise coupling of the modes in a uniform system, the multimode coupling in uniform systems, and the nonuniform systems. The report also includes a development of the Casimir operators of a seisimple algebra. Author

N64-28917 Tennessee U., Knoxville
AN EXAMINATION OF THE FAR INFRARED SPECTRUM OF HYDROGEN FLUORIDE Scientific Report No. 5
Arthur Allen Mason and Alvin H. Nielsen Aug. 1963 144 p refs
(Contract AF 19(604)-7981)
(AFCRL-63-863; AD-604168)

The purpose of the investigation was to determine the frequencies, the ground state rotational constants, the intensities, and the half-widths of as many of the pure rotational absorption lines of HF as could be measured. The general techniques of far infrared instrumentation and their application to the instruments used are discussed and explained. The vacuum wave numbers of the line centers of the first seventeen lines of the pure rotational spectrum of HF were measured, and B_0, D_0, and H_0 were determined. Equivalent widths for 15 lines were found to be directly proportional to pressure over the range of measurements. The line strengths and half-widths were determined by the method of equivalent widths. Author

N64-28928 Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, June 1964
R. M. Adams and A. Glassner 21 Jul. 1964 110 p refs
(Contract W-31-109-ENG-38)
(ANL-6912) OTS: $2.25

The report discusses boiling water reactors, liquid-metal-cooled reactors, general reactor technology, advanced systems research and development, nuclear safety, and publication list. A.W.

N64-28932 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
A PHENOMENOLOGICAL MODEL APPLIED TO K^+-Σ^0 PHOTO PRODUCTION
Jean DuFour Jul. 1964 11 p refs
(TH-63)

In a recent paper, a phenomenological model was applied to $\gamma + p \rightarrow K^+ + \Lambda$ reaction in order to account for angular distributions and polarization of the Λ hyperon related to this process. This model, which includes Born terms and the K^* meson, takes into account the pion-nucleon interaction in the direct channel through the third π-N resonance. In this report, an analogous model is applied to $\gamma + p \rightarrow K^+ + \Sigma^0$ photoproduction. That case is considered where K is pseudoscalar with respect to Σ. Born terms and the K^* meson are included in the model and also the pion-nucleon resonance (P 3/2, 3/2). Since no measure of Σ^0 polarization has yet been performed, a zero width in Breit–Wigner form describing the multipoles is taken in the first approximation. Consequently, the production amplitude shall be real. On the other hand, the well-known result about the character of $\gamma N \rightarrow N^* \rightarrow \pi N$ transition, which is essentially magnetic, is used and, therefore, the electric dipole is neglected. I.v.L.

N64-28934* Radiation Research Associates, Inc., Fort Worth, Tex.
A MONTE CARLO STUDY OF THE TRANSPORT OF NEUTRONS RESULTING FROM PROTON-INDUCED NUCLEAR EVAPORATION
M. B. Wells 12 Jun. 1964 30 p refs Presented at the 1964 Am. Nucl. Soc. Meeting, Philadelphia 14–17 Jun. 1964
(Contract NAS8-11047)
(NASA-CR-58493; RRA-M43) OTS: $2.60 ph

Monte Carlo methods are being used in performing a parameter study of the transport of neutrons through slabs of aluminum, polyethylene, carbon, and iron for use in further machine calculations of the neutron dose in space vehicles resulting from proton-induced nuclear evaporation. The calculations being performed are for plane isotropic monoenergetic neutron sources located at various depths within a slab shield. The source plane locations and source energies were selected so that data for slabs of up to 30 cm thick and source energies between 0.5 Mev and 14 Mev could be obtained by interpolation from the Monte Carlo calculations. The results obtained to date are mainly from aluminum and show that the amount by which the boundary effects influence the dose rate transmitted through slabs is highly dependent on both the location of the plane isotropic source within the slab and the slab thickness. Author

N64-28973* Alabama U. Research Inst., Huntsville
PARABOLIC AND ELLIPTIC WAVEGUIDES CONSIDERED BY CONFORMAL MAPPING
F. J. Tischer and H. Y. Yee May 1964 17 p refs
(Grant NsG-381)
(NASA-CR-56796; UARI-RR-16) OTS: $1.60 ph

The cross section of an arbitrarily shaped waveguide is transformed into a rectangle. The rectangular guide is filled with a nonuniform anisotropic medium with a distribution such that the propagation properties are the same. Feenberg's perturbation method and the Rayleigh–Ritz method can be used for determining the propagation characteristics and the field distribution of the rectangular guide. The propagation constants of parabolic and elliptic guides are determined by both methods and are compared with the exact values. Author

N64-28990* New York U., N.Y.
ELECTRONIC STATES OF MOLECULES. I. SELF-CONSISTENT FIELD CALCULATIONS OF THE GROUND, IONIZED AND EXCITED STATES OF N_2 AND O_2
R. C. Sahni and E. J. De Lorenzo [1960] 27 p refs
(Grant NsG-76)
(NASA-CR-58343) OTS: $2.60 ph

A number of electronic states of N_2 and O_2 were computed using the self-consistent field molecular orbital method. The calculated ionization, excitation, and total energies are compared with the available experimental data as well as with those reported by other workers. Author

N64-29010 General Mills, Inc., Minneapolis, Minn. Electonics Div.
STRATOSPHERIC TEMPERATURE AND WIND FIELDS ALONG 80° W, 1957–1959 Final Report, 15 Apr. 1960–15 Jun. 1964
D. G. Dartt and A. D. Belmont 15 Jun. 1964 66 p refs
(Contract Nonr 1589(20))
(FR-2581; AD-601587)

The stratospheric temperature and zonal wind fields along 80° W in the Northern Hemisphere are analyzed and compared for the years 1957, 1958, and 1959. Meridional patterns of

heating and cooling are discussed in terms of the recurrent quasi-biennial, annual, and semiannual temperature cycles, as well as sporadic sudden warmings. Changes in the speed and direction of the zonal winds are described in terms of variations of the large-scale meridional temperature gradients. The wind and temperature fields of the stratosphere generally correspond except wherever there is a temperature gradient reversal between the troposphere and stratosphere. In these cases, the direction of the winds of the lower stratosphere correspond to the tropospheric temperature gradient, although their change in speed with height is according to the thermal gradient in the stratosphere. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-27878* North Carolina State Coll., Raleigh
ON THE TRANSPORT PROPERTIES OF A PARTIALLY IONIZED GAS IN THE PRESENCE OF ELECTRIC AND MAGNETIC FIELDS
H. A. Hassan 1964 19 p refs
(Grant NsG-363)
(NASA-CR-58210) OTS: $1.60 ph

The transfer equations as given by Burgers are used to give explicit expressions for the diffusion velocities, the heat flux vectors, and the stress tensors of the constituents of a partially ionized gas. The calculation takes into consideration the presence of electric and magnetic fields and pressure, temperature, concentration, and velocity gradients. The results correspond to what is normally referred to as a "second approximation." Author

N64-27909* Stanford Research Inst., Menlo Park, Calif.
THE USE OF THE LANGMUIR PROBE TO DETERMINE ELECTRON DENSITIES SURROUNDING RE-ENTRY VEHICLES Final Report
W. E. Scharfman Jan. 1964 53 p refs
(Contract NAS1-2967; SRI Proj. 4556)
(NASA-CR-56371) OTS: $5.60 ph

An experimental investigation of the operation of electrostatic probes in a flowing plasma was carried out to determine the operation of such probes when the probe radius is comparable to, or larger than, the mean free path. The investigation was carried out in an electromagnetic shock tube capable of producing plasma flows greater than 1 cm/μsec and electron densities greater than 10^{14} electrons/cc. The voltage applied to the probes was sinusoidally varied at a 100-kilocycle rate, so that electron temperature and electron density could be obtained from the current-voltage characteristics. Probe results were compared to the microwave results and to each other. Good agreement was obtained between the microwaves and the probes as well as between probes, even when the mean free path was one-fifth the probe radius. All probe data were interpreted by using free molecular theory. Author

N64-27958 Michigan U., Ann Arbor. Electron Physics Lab.
NONLINEAR BEAM-PLASMA INTERACTIONS
J. E. Rone Mar. 1964 65 p refs
(Contract AF-33(657)-8050)
(TR-69; AD-602452)

The nonlinear interaction phenomenon involving a beam-plasma-electromagnetic wave combination is investigated, using a Lagrangian method to calculate particle trajectories and energy conversion. Although collision effects are neglected, finite temperature streams are treated by assigning appropriate particle distribution functions in velocity-phase space. Numerical calculations are presented for multiple stream and beam-plasma configurations with and without propagating slow electromagnetic waves. Author

N64-27962 California U., Berkeley Electronics Research Labs.
PLASMA HEATING BY INJECTION OF CHARGED PARTICLES
A. Hasegawa and C. K. Birdsall 13 Mar. 1964 192 p refs
(Contracts AF-AFOSR 139-63; AF 33(657)-7614; AF 33 (615)-1078)
(Rept.-64-5; AD-601417)

Obtaining a high-temperature plasma is a basic difficulty in problems of controlled fusion. Various methods were proposed, such as injection of a stream of charged particles into the plasma. Here, the kinetic and electromagnetic energy of the stream is expected to be converted to plasma thermal energy. The present work analyzes various processes that may occur in the energy conversion from stream to plasma. These processes are collision interactions and high-frequency interactions between the stream and plasma. More emphasis is given to the latter. In the high-frequency interaction category, two types of interactions are considered. One is the plasma-wave interaction in which the wave is set up by the plasma oscillatory motion of particles; the other is the cyclotron-wave interaction in which the wave is supported by the cyclotron motion of the particles. The latter is more useful of the two because the interaction is selective with respect to the sign of the charge of the particles that offers the possibility of selective heating of the ions in the plasma, and the transverse-kinetic energy of the plasma particle is increased. A sheet current plasma model is constructed for the analysis of cyclotron-wave interaction that is capable of treating both the nonlinear and the random processes. The model has no transverse variations; it is solved on a high-speed computer. Author

N64-27999 Utah U., Salt Lake City Microwave Devices Lab.
PLASMA STUDIES
P. O. Berrett, C. C. Johnson et al *In its* Consolidated Quart. Rept., Jan. 1–31 Mar. 1964 31 Mar. 1964 p 68–77 ref
(See N64-27996 23-20)

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3. PLASMA FOR A COUPLING MEDIUM V. A. Gilson and C. C. Johnson p 73–75
4. ROCKET EXHAUST STUDIES O. Barker, K. Bullock, C. C. Johnson, D. H. Durney, and R. W. Grow p 75–76
5. SUPERCONDUCTIVITY S. M. Chou and C. C. Johnson p 76–77

N64-28003 Institut für Plasmaphysik G. m. b. H., Garching/W. Germany/
EXCITATION LEVEL OF PLASMA OSCILLATIONS
M. Feix May 1964 30 p refs
(Sponsored by EURATOM)
(IPP/6/18)

To get more insight in the phenomena of plasma oscillations, the amplitudes of the different contributions in the free oscillation problem were compared (poles due to the plasma and the initial conditions). For small k, only the Landau poles are excited and they will play the dominant role already at time t = 0. In the problem of forced oscillations by a macroscopic electric field, the Landau solutions are dominant for frequency close to ω_p. Finally the behavior of the transient cloud around an initially correlationless test particle is dominated by the waves with a group velocity equal to the test particle velocity. Author

N64-28016 Canadian Armament Research and Development Establishment, Valcartier Defence Research Board

A MICROWAVE-PLASMA INTERACTION MODEL TO STUDY THE HEAD-ON RADAR CROSS SECTION OF BLUNT BODIES UNDER REENTRY CONDITIONS

M. Gravel and M. Waymel Aug. 1964 21 p refs

(ARPA Order-133)

(CARDE-TR-507)

A physical optics model is being developed to study the influence of the plasma sheath on the head-on radar cross section of blunt bodies. According to this model the large variations in radar cross section observed experimentally in hypersonic ranges with small metal spheres would be mainly the result of an interference between the signal reflected at the vertex from the surface of the opaque region of the plasma sheath and the signal reflected from the part of the surface of the sphere, which is not covered by an opaque plasma. As the velocity of the sphere increases, the opaque region spreads over the surface to produce Fresnel interferences that are successively destructive and constructive until the sphere is completely eclipsed by overdense layers. The theoretical analysis also leads to the determination of an angular electron distribution within the plasma sheath that agrees well with theoretical flow-field calculations made subsequently. Author

N64-28020 Yale U. Observatory, New Haven, Conn.

INTERACTION OF FAST CHARGED PARTICLES WITH A PLASMA Interim Technical Report

Martin D. Altschuler Wright-Patterson AFB, Ohio, ARL, Jul. 1964 254 p refs

(Contract AF 33(657)-7271)

(ARL-64-111; AD-601658)

The hydromagnetic equations are solved for the electrostatic field distribution of a charged test particle in a plasma. When electrons are accelerated by the electrostatic field of the test particle they emit electromagnetic radiation. The spectrum of this radiation is calculated. When the test particle moves slower than the thermal electron speed, the electrostatic field of the test particle is a shielded and distorted Coulomb potential (i.e., a distorted Debye potential). The resulting electromagnetic radiation has a spectrum that agrees, in the low- and high-frequency limits, with the results of other researchers. When the test particle moves faster than the thermal electron speed, the plasma perturbations are contained within a Mach cone trailing the test particle. The resulting electromagnetic radiation has a resonance at $\omega_e[1 - V^2/u^2]^{-1/2} > \omega_e$ where ω_e is the plasma frequency and V and u are the thermal electron speed and test particle speed, respectively. When two or more test particles move together supersonically through the plasma, even harmonics of the resonant frequency arise in a natural manner. Author

N64-28063* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTS WITH A CO-AXIAL HALL CURRENT PLASMA ACCELERATOR

William Grossmann, Robert V. Hess, and H. A. Hassan (N.C. State Coll.) N.Y., AIAA [1964] 18 p refs Presented at AIAA Fourth Elec. Propulsion Conf., Philadelphia, 31 Aug.-2 Sep. 1964

(AIAA Paper-64-700) AIAA: $0.50 members, $1.00 nonmembers

The intent of this paper was to present the results of a theoretical and experimental study of a relatively high mass-flow-rate (2 to 5 grams per second) coaxial plasma accelerator. This study included measurements of arc characteristics, electron temperatures and densities, Hall-current densities, thrust and specific impulse, electrode and overall efficiencies versus the important operating parameters, such as arc current, mass-flow rate and magnetic-field strength. A theoretical analysis performed agreed very well with the experimental results. The experimental results indicated that efficient operation can be obtained at low mass-flow rates, for example, 0.01 gram/sec. The original experiments and the subsequent later low mass-flow-rate experiments were performed mainly with argon as the propellant gas. The original experiments were carried out at low power inputs so that clean plasma diagnostic studies could be made of the important plasma properties. In view of the rather striking results obtained with the low mass-flow-rate experiments and much higher power inputs, this paper is concerned with the coaxial Hall-current plasma accelerator configuration. Author

N64-28077* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

RESEARCH ON A ONE-INCH-SQUARE LINEAR D-C PLASMA ACCELERATOR

A. F. Carter, G. P. Wood, D. R. Mc Farland, and W. R. Weaver N.Y., AIAA [1964] 26 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.-2 Sep. 1964

(AIAA Paper-64-699) AIAA: $0.50 members, $1.00 nonmenbers

Some recent results from a continuing research program on plasma accelerators are reported for an accelerator that has a channel 1 in. square and 12 in. long. This accelerator uses nitrogen seeded with 0.3-percent mole fraction cesium and operates at relatively high pressure (50-mm Hg) and high magnetic field (11,500 gauss). Power input to the accelerator is about 360 kw with about 50 amperes through each of 24 electrode pairs. The 1,200-volt axial potential difference that is self-generated in the plasma between the ends of the accelerator has posed operational problems. This high voltage tends to find closed circuits to ground and back through many paths. Steps taken to alleviate these problems are described. Another problem is the erosion of the trailing edges of anodes and adjacent insulators because of the concentration of currents there due to large values of $\omega\tau$. Experience with this effect is described. Time-of-flight velocity measurements were made with injected spark and image-converter framing camera. Velocity at entrance is 6,500 ft/sec and at exit 20,000 ft/sec, and exit density is 10^{-4} lb/ft^3. Author

N64-28161 Aerospace Corp., El Segundo, Calif. Plasma Research Lab.

RADIATION FROM A LINE SOURCE IN A GROUND PLANE COVERED BY A WARM PLASMA SLAB. GENERAL RESEARCH

P. R. Caron and G. E. Stewart 31 Jul. 1964 68 p refs

(ATN-64(9230)-3; AD-444117)

The problem of a magnetic line source in a ground plane coated with a warm plasma slab is investigated. Consideration is given to electromagnetic and plasma waves in the slab and to the coupling at the boundaries between these waves and the free space fields. An integral expression for the radiation field is obtained and is evaluated by the method of steepest descent. The resulting radiation patterns display interesting effects due to electron pressure, and these are discussed with the help of the transmission line analog to the problem. The surface wave poles are located and discussed, using this same analog. Author

N64-28339* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

SEMICLASSICAL CALCULATION OF THE DIFFERENTIAL SCATTERING CROSS SECTION WITH CHARGE EXCHANGE: CESIUM IONS IN CESIUM VAPOR

John W. Sheldon Washington, NASA, Sep. 1964 39 p refs (NASA-TN-D-2484) OTS: $1.00

The differential scattering cross section of an ion in its parent gas is calculated for an inverse fourth attractive (polarization) potential. The effect of charge exchange is included. The ion and atom paths during collision are computed classically, but the results of quantum mechanical charge exchange probability calculations are used. Expressions are given for the range of energy and scattering angle over which this semiclassical approach is valid. The differential cross section is shown to have a maximum near an apparent scattering angle of 180°. Approximate expressions are given for the value of the cross section at the maximum and the scattering angle at which it occurs. Values of the differential cross section for cesium ions in cesium vapor are obtained by using the results of total charge exchange cross section and atomic polarizability measurements. These calculations are expected to be valid for cesium ion-atom collision energies between 0.025 and 1.000 electron volts. The relation between total cross section, charge exchange cross section, and diffusion cross section is discussed. The determination of the total cross section from a scattering chamber type experiment is presented and compared with experiments. Author

N64-28354* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE VECTOR POTENTIAL AND MOTION OF CHARGED PARTICLES IN AXISYMMETRIC MAGNETIC FIELDS

David Stern Repr. from J. of Geophys. Res., v. 69, no. 13, 1 Jul. 1964 p 2715–2719 refs (NASA-RP-293)

Analysis using the conventional expansion of a scalar magnetic potential (such as the earth's) to derive an expansion of the vector potential was made. This expansion is used for analyzing the motion of charged particles in axisymmetric magnetic fields, with special attention to such fields that do not deviate far from a dipole. The results are compared with those of Quenby and Webber. The relation between Störmer's first integral and the third adiabatic invariant is traced. IAA

N64-28368* General Electric Co., King of Prussia, Pa. Space Sciences Lab.

X-BAND MAGNETIC RESONANCE PLASMA ACCELERATOR

David B. Miller, N.Y., AIAA [1964] 20 p refs Presented at AIAA 7th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964 (Contract NAS3-3567) (AIAA Paper-64-702) AIAA: $0.50 members, $1.00 nonmembers

The experimental electron-cyclotron-resonance accelerator described employs a circularly polarized, TE_{11} circular waveguide mode electromagnetic field to energize the plasma. The frequency is 8,350 mc, and operation to above 3-kw incident RF power was achieved. Argon plasmas were used, with flow rates in the range 0.3 to 1 mg/sec. Continuous operating times have typically been several minutes. Measurements include incident and reflected RF power, RF field penetration in the plasma, power lost to the accelerator walls, and particle-flux and energy diagnostics in the emerging plasma stream. The dependencies of plasma characteristics on controllable parameters (RF power, gas flow rate and magnetic field) are described. It is for instance observed that at 0.4 mg/sec argon flow rate and 3,200-w incident RF power, over 90% of the RF power is transferred to the plasma, and power conversion efficiency (plasma exhaust stream power–incident RF power) is 25%. The RF–plasma boundary is a centimeter thick. Recent design modifications resulted in an approximate doubling of power conversion efficiency. Author

N64-28369* General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.

AN ENERGY INVENTORY IN A COAXIAL PLASMA ACCELERATOR DRIVEN BY A PULSE LINE

A. V. Larson, T. J. Gooding, B. R. Hayworth, and D. E. T. F. Ashby N.Y., AIAA [1964] 8 p refs Presented at AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964 (Contract NAS3-2594) (AIAA Paper-64-704) AIAA: $0.50 members, $1.00 nonmembers

A description is given of energy measurements in a coaxial plasma gun. The energy source is a pulse line that is essentially an extended foil capacitor wound on a large diameter core; when discharged into the gun it delivers 200 ka at 3 kv with a rise time of 0.1μsec. The partition of energy between the source, magnetic field, and work done on the plasma is determined from measurements of the magnetic field distribution inside the gun together with the voltage and current at the gun terminals. Eighty-eight percent of the stored energy is delivered to the gun initially, of which roughly half is a magnetic field. Some magnetic energy is withdrawn before crowbar but finally 58% of the stored energy does work on the plasma. Calorimetric measurements show that only 15% of the stored energy appears in the exhaust; this percentage doubles if the barrel is shortened from 13 to 8 cm. The results are discussed on the basis of a shock model in which the plasma radiates its internal energy. Author

N64-28370* General Dynamics/Astronautics, San Diego, Calif. Plasma Propulsion Group

EXHAUST MEASUREMENTS ON THE PLASMA FROM A PULSED COAXIAL GUN

D. E. T. F. Ashby, T. J. Gooding, B. R. Hayworth, and A. V. Larson N.Y., AIAA [1964] 8 p refs Presented at AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964 (Contract NAS3-2594) (AIAA Paper-64-705) AIAA: $0.50 members, $1.00 nonmembers

Measurements made on the nitrogen plasma from a pulsed coaxial plasma gun intended for space propulsion are described; the techniques used are generally applicable to exhaust measurements in pulsed MHD propulsion engines. A negatively biased Faraday Cup, enclosed in a grounded shield, is used to measure the ion density and the directed ion velocity; this technique, previously used on hydrogen plasmas in controlled thermonuclear fusion, is now applied to nitrogen

plasmas with ion densities up to $3 \times {}^{13}\ cm^{-3}$ and with directed ion velocities from 10^6 cm sec^{-1} to 10^7 cm sec^{-1}. The ion energy per unit cross section of exhaust is calculated from the data given by the Faraday Cup and compared with the energy per unit cross section measured with a small calorimeter. An electrostatic analyzer with a biased grid is used to check the Faraday Cup and to determine the ratio e/M for the ions.

Author

N64-28420 Princeton U., N.J. Plasma Physics Lab.
DIAMAGNETIC PERPENDICULAR TEMPERATURE MEASUREMENT OF THE HELIUM DISCHARGE IN THE C STELLARATOR
Koji Uo Jun. 1964 22 p refs
(Contract AT(30-1)-1238)
(MATT-278)

Described is the perpendicular temperature measurement of a helium discharge in the C Stellarator plasma. To compare the diamagnetic temperature with the doppler temperature, the diamagnetic temperature measurement on the helium discharge was carried out under the same conditions as Hirschberg's experiment. The perpendicular temperature is computed for several bell-shaped plasma density distributions. When the appropriate density distribution is assumed, the agreement between the diamagnetic and the resistivity temperature is fairly good. The discrepancy is about 20%. The diamagnetic temperature is closely proportional to the resistivity temperature except for the period at the end of the discharge. The data suggest that at late time, the ohmic heating current is carried by runaway electrons and that the resistivity determination then leads to an overestimate of electron temperature. Author

N64-28421 Princeton U., N.J. Plasma Physics Lab.
A BIBLIOGRAPHY ON MAGNETIC DIFFUSION AND DRIFT INSTABILITIES
Francis F. Chen Jun. 1964 23 p refs
(Contract AT(30-1)-1238)
(MATT-285)

N64-28422 Princeton U., N.J. Plasma Physics Lab.
EXTENSION OF SUYDAM'S CONDITION FOR PLASMA STABILITY TO INCLUDE FINITE LARMOR RADIUS EFFECTS
T. E. Stringer Jul. 1964 7 p refs
(Contract AT(30-1)-1238)
(MATT-289)

When finite Larmor radius effects are included in the equations for the interchange mode, the conditions for stability of confined plasmas are eased. The same analysis is applied to the equations describing the interchange mode in a cylindrical plasma. This gives the modified form of Suydam's criterion where the critical value of the Suydam parameter is now a function of the ratio of ion Larmor radius to the scale length of the equilibrium pressure distribution. A.W.

N64-28423 Princeton U., N.J. Plasma Physics Lab.
ELECTRON CYCLOTRON HARMONIC RADIATION FROM A PLASMA
A. F. Kuckes and J. M. Dawson Jul. 1964 7 p refs
(Contract AT(30-1)-1238)
(MATT-290)

Computations are presented that support the hypothesis that the microwave radiation emitted from plasmas immersed in magnetic fields at harmonics of the electron cyclotron frequency is due to energetic electrons gyrating in a region of plasma hybrid resonance. M.P.G.

N64-28457 Ohio State U. Research Foundation, Columbus Antenna Lab.
FAR INFRARED MEASUREMENT OF AIR
R. De Vore and J. J. Komar 31 Mar. 1964 24 p refs
(Contract AF 33(657)-10426)
(Rept.-1565-7; AD-441333)

An arc-heated plasma tunnel was employed as a continuous source of high-temperature air. Three separate measurements in the 188 to 178-cm^{-1} spectral region were made to check the system and investigate the possibility of observing NO rotational lines in emission. Two NO lines were probably resolved, although the heating of the metal cabin enclosing the test stream impeded the accuracy of the measurements. Author

N64-28517* MHD Research, Inc., Newport Beach, Calif.
DESIGN AND PERFORMANCE STUDY ON A 500 KILOWATT LINEAR CROSSED-FIELD AIR-PLASMA ACCELERATOR FOR A RE-ENTRY SIMULATION FACILITY
R. C. Brumfield, S. Demetriades, P. D. Lenn, D. L. Ward, and G. Bedjai, Northrop Corp. 18 Mar. 1964 151 p refs
(Contract NAS2-1170)
(NASA-CR-58543; MHD-648) OTS: $11.50 ph

The design and performance of two models of 500-kw linear crossed-field air-plasma accelerators are described. The electromagnetic design, materials selections, and configuration are included. The results of seven full-scale operating tests on the two accelerator configurations are given. The performance requirements are to accelerate an airstream of 0.01 lb/sec to a velocity of 25,000 fps with a steady, uniform velocity to within 5% over a core flow area of 0.2 sq ft for a period of 5 minutes and with less than 1% contamination. Experiments were run by heating and accelerating with an arc plasma generator and de Laval nozzle. The resulting supersonic jet was fired into an expanding accelerator channel with transverse, serial electrode discharges and a perpendicular applied magnetic field. Author

N64-28617 University of Southern Calif., Los Angeles School of Engineering
RESEARCH IN PLASMA AND MAGNETOHYDRODYNAMICS Final Report
Zohrab A. Kaprielian Dec. 1963 26 p refs
(Grant AF-HFOSR-188-63)
(USCEC-103-101; EE-35; HFOSR-64-1137; HD-601766)

The research reported involves theoretical and experimental work in two major areas: plasma diagonostics and the measurements of thermal radiation from a highly ionized current carrying plasma. Author

N64-28634 California U., La Jolla
INSTABILITY IN THE QUANTUM HELICON DISPERSION RELATION
N. David Mermin and V. Celli 17 Jun. 1964 29 p refs
(Contract Nonr-2216-(11))
(TR-21; AD-602038) OTS: $0.75

The classical stability theorem for the conventional thermal equilibrium state of an electron gas in a uniform magnetic field is generalized to the semiclassical case; to the quantum case when there is no magnetic field; and to the quantum case in the presence of a magnetic field, provided only Coulomb interactions are retained. However when the quantum gas in a magnetic field is treated with all electromagnetic interactions, at very low temperatures it becomes unstable against transverse excitations propagating in the direction of the field. This instability appears as a root of the quantum helicon dispersion

relation in the upper-half frequency plane. The instability is due to the failure of the conventional Hartree ground state to minimize the ground state energy, when magnetic current–current interactions are retained along with the Coulomb interactions. A state giving a lower energy than the conventional one, in which transverse volume currents exist perpendicular to the magnetic field, was found. Author

N64-28644 Stanford Research Inst., Menlo Park, Calif.
THE ROLE OF ALUMINUM AND ITS OXIDES AS SOURCES OR MODERATORS OF ELECTRONS IN SOLID PROPELLANT ROCKET EXHAUSTS Quarterly Status Report Jan. 1–Mar. 31, 1964
G. Neil Spokes [1964] 67 p refs
(Contract AF 04(694)-128)
(QSR-7; AD-602218)

Preliminary machine computations of electron distributions about a thermionically emitting particle are presented. Further work on ion sampling from chemical plasmas has shown that the process involves competition between hydrodynamic flow and the local electric fields at a sampling aperture. Further results are presented for flames and for nitrogen afterglows. Author

N64-28716 California U., La Jolla
LONG WAVELENGTH OSCILLATIONS OF A QUANTUM PLASMA IN A UNIFORM MAGNETIC FIELD II
Vittorio Celli and N. David Mermin 11 Jun. 1964 42 p
(Contract Nonr-2216(11))
(TR-22; HD-602039)

The self-sustained oscillations of a quantum mechanical electron gas in a uniform magnetic field are discussed in the time-dependent Hartree approximation, or random phase approximation. The full electromagnetic interaction between electrons is taken into account, and spin effects are included. The resulting dispersion relation reduces to the Appleton–Hartree equation of classical magnetohydrodynamics in the limit of long wavelengths. This classical equation holds even for a highly degenerate electron gas or for magnetic fields so strong that only a few Landau oscillator levels are appreciably occupied. The validity of long wavelength expansions is discussed for the various normal modes, particular attention being given to the low frequency transverse mode, a particular case of which is the helicon or whistler. Author

N64-28757* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPINOR FORMULATION OF MAGNETOGAS DYNAMICS
Lawrence A. Schmid Mar. 1964 172 p refs
(NASA-TM-X-55001; X-640-64-55) OTS: $12.50 ph

This report shows that all the variables needed for a classical description of the dynamical behavior of a fluid, consisting of electrically charged particles having a spin, can be incorporated into two spinors having a total of four complex elements. The particle spin is included, not because it plays any significant role in magnetogasdynamic problems, but because it is needed to account for all the degrees of freedom of the spinors. The link between the spinors and the familiar quantities that describe the fluid is provided by the "particle tetrapod" consisting of one time-like and three space-like 4-vectors. These vectors constitute an orthonormal system and are normalized to the particle density of the fluid in its local rest frame. The time-like vector is identified with the flux density of the fluid; one space-like vector is used to specify the orientation of the particle spin axis; and the remaining degree-of-freedom (an angle) is postulated to be proportional to the de Broglie phase, the proportionality constant being Planck's constant. I.v.L.

N64-28832* Pennsylvania State U., University Park College of Engineering
NOTES ON MAGNETOHYDRODYNAMICS, PART I Scientific Report No. 218
R. P. Kanwal 1 Sep. 1964 110 p refs
(Grants NsG-134-61; NSF G-24473)
(NASA-CR-58347) OTS: $9.10 ph

Equations of motion are presented. General properties, such as Bernoulli's theorem for steady flow and magnetohydrostatic problems, are discussed. Boundary-value problems—plane Couette flow, Rayleigh's problem of unsteady motion of a plate, and Stokes flow—are examined. The propagation of sound waves is investigated. Differential effects of shock waves, various speeds of shock propagation, and other wave problems are considered. G.D.B.

N64-28874 Naval Research Lab., Washington, D.C.
STARK BROADENING OF ISOLATED SPECTRAL LINES IN A PLASMA
H. R. Griem (Maryland U.) 16 Jun. 1964 70 p refs
(NRL-6084; AD-443762)

Stark broadening parameters for spectral lines from neutral and singly ionized atoms broadened and shifted by the local fields of both electrons and ions in a plasma are calculated in the classical path approximation. The electron collisions are treated by an impact theory allowing for deviations from adiabaticity and the ion effects by the quasi-static approximation in which electron shielding and ion-ion correlations are taken into account. An accuracy of about 20% in the resulting line profiles is expected, except for the position of the intensity maxima of lines with relatively small shifts and for ion lines from highly excited levels. Stark broadening parameters for many of the stronger multiplets of first and second spectra of light and medium elements are tabulated. Author

N64-28921* Columbia U., New York, N.Y. Plasma Lab.
THEORETICAL RESEARCH INVESTIGATIONS IN PLASMA PHYSICS AND MAGNETOGASDYNAMICS Final Report
Robert A. Gross 10 Jun. 1964 3 p refs
(Grant NsG-302-63)
(NASA-CR-56944) OTS: $1.10 ph

Résumés are presented of studies in the following areas: (1) plane gasdynamic and transverse magnetogasdynamic shock waves in fully ionized hydrogen at conditions such that radiative processes are significant; (2) the transmission of very low frequency waves from the exosphere down to the surface of the earth; and (3) the effect of compressibility on Kelvin–Helmholtz instability in the two limiting cases of a plasma of very small compressibility and a plasma of very large compressibility. M.P.G.

N64-28923* Avco-Everett Research Lab., Everett, Mass.
ON THE USE OF MAGNETOHYDRODYNAMICS DURING HIGH SPEED RE-ENTRY
P. O. Jarvinen Jul. 1964 62 p refs
(Contract NASw-748)
(NASA-CR-58042; Avco-Everett Res. Note-463) OTS: $6.60 ph

The use of the interaction of a magnetic field with a hypersonic flow to effect the decelerations and heating encountered during reentry is considered. The equations of motion that describe the reentry history of nonlifting vehicles employing magnetohydrodynamic interactions with the flow field are simplified in the manner of Allen and Eggers. Analytical expressions are derived for the velocity history, deceleration history, and the altitude and magnitude of peak heating and deceleration for reentries involving both low or high magnetic Reynolds

number interactions. In both cases it is found that the maximum heating and deceleration experienced can be reduced significantly below that encountered by purely aerodynamic vehicles. Author

N64-28924* Avco-Everett Research Lab., Everett, Mass.
A MULTITEMPERATURE BOUNDARY LAYER
Morton Camac and Nelson H. Kemp Jun. 1964 22 p
(Contract NASw-748)
(NASA-CR-58041; Avco-Everett Res. Note-387) OTS: $2.60 ph

This is a preliminary report on an analytical investigation of the end-wall boundary layer behind a reflected shock in a shock tube in highly ionized argon. Two nonequilibrium effects are considered—chemical nonequilibrium because of finite recombination rates, and lack of equilibration between electron and heavy (atom and ion) temperatures because of a finite rate of energy exchange due to elastic collisions between electrons and ions. The Debye length is small compared to the boundary-layer thickness. The electrical effects principally manifest themselves in a plasma sheath next to the wall. In this sheath the simple molecular description of the plasma originated by Langmuir and Mott-Smith is used. Outside the sheath, in the aerodynamic boundary layer, the usual continuum fluid mechanics treatment is used. These two descriptions of the plasma are joined at the sheath edge by requiring continuity of ion mass flux and electron energy flux, which serve as boundary conditions for the continuum boundary-layer equations. The basic information determining the chemical and transport properties of ionized argon are well known, and they are used to develop a set of properties for the two-temperature case considered here. Author

N64-28940* Columbia U., New York, N.Y. Plasma Lab.
ON RADIATIVE SHOCK STRUCTURE
Paul A. Koch (M. S. Thesis) Mar. 1964 173 p refs
(Grant NsG-302-63)
(NASA-CR-58338; Rept.-9) OTS: $12.50 ph

A study is made of plane gas dynamic and transverse magnetogasdynamic shock waves in fully ionized hydrogen, at conditions such that radiative processes are significant. An established steady-state flow is found to exist for these waves only in astrophysical cases, since the wave thicknesses in such a flow are quite large. In the case of such an established flow the Rankine-Hugoniot jump equation (i.e., the relationship between the flow variables in the initial and final states) is analyzed and then solved numerically. The differential equations that describe the above shock waves are analyzed. The result is a set of four simultaneous nonlinear ordinary first-order differential equations, the solution of which gives the structure of the shock, i.e., the dependence of the flow variables on position within the shock wave. Author

N64-29003* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SIMPLE PROOF OF THE IDENTITY OF LANDAU'S AND van KAMPEN'S SOLUTIONS OF THE LINEARIZED VLASOV EQUATION
Ching-Sheng Wu 15 Apr. 1964 9 p refs
(Contract NAS7-100)
(NASA-CR-58667; JPL-TR-32-627) OTS: $1.10 ph

In a generalized analysis, Case has shown that the electrostatic potentials obtained in Landau's and van Kampen's solutions to the collisionless Boltzmann equation are equivalent. The purpose of this report is to furnish a simple explicit proof of the complete identity of Landau's and van Kampen's solutions; the analysis, however, follows a course different from that of Case. Author

N64-29015 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF A MAGNETIC FIELD ON PHENOMENA IN A DIODE WITH CESIUM VAPORS
N. D. Morgulis and Yu. I. Chutov 19 Jun. 1963 17 p refs
Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 7, no. 9, 1962 p 1003-1012
(FTD-TT-63-351/1+2; AD-414505)

The effect of a magnetic field on an electron short-circuit stream and on the characteristics of the entire stream was investigated in a decelerating electric field in a cesium plasma diode. The physical data obtained indicate that the behavioral features of the cesium plasma diode provide a close model of a thermal electron-energy transformer. It therefore seems probable that future practical transformers of this type will be capable of functioning in the arc condition, and that the influence of the eigen magnetic field formed by the converter current will not affect its operation. M.P.G.

N64-29017 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLICATION OF THE SIMILARITY METHOD TO INVESTIGATE THE MOVEMENTS OF POWERFUL BEAMS OF CHARGED PARTICLES IN HIGH VOLTAGE ELECTROSTATIC FIELDS
A. K. Val'ter and V. Ye. Finkel'shteyn 25 Jul. 1963 10 p
Transl. into ENGLISH from Uch. Zap. Khar'kovsk. Univ. (USSR), v. 6, no. 64, 1955 p 95-100
(FTD-TT-63-514/1+2; AD-414834)

The focusing properties of beams of charged particles in high-voltage electrostatic fields are analyzed with the aid of experiments on similar low-voltage models and the similarity criterion. The effects of the space charge and of a statistical discrepancy in the initial velocities of the particles are included in the analysis. If a sufficiently good vacuum is maintained in the tube, the secondary ionization of gases remaining in the tube does not distort the results obtained. M.P.G.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-27928 Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
DEVELOPMENT OF EPITAXIAL TECHNOLOGY FOR MICROELECTRONICS AND LARGE AREA DEVICE APPLICATION Quarterly Report, 1 Feb.-30 Apr. 1964
P. Wang, B. Selikson, and R. Berkstresser 1 Jun. 1961 47 p
(Contract NObsr-85431)
(QR-8; AD-601343)

Experiments were carried out in conjunction with the study of arsine doping, CO_2 in situ oxide film growth, and oxide-masked growth. The furnace with rotating susceptor

was re-evaluated with much more favorable results than previously obtained. Capacitance probe measurement has proven a very valuable technique, useful for the study of layer doping profile, isolation junctions, and back diffusion in epitaxial layers. Desirable doping profile in epitaxial layers for digital circuits was obtained, and a preliminary study was conducted on the requirements of epitaxial layers for linear circuits. A separate but smaller effort on silicon thin-film deposition on ceramic substrates was made, with no major technical breakthroughs in sight. Author

N64-27933 Harry Diamond Labs., Washington, D.C.
FERROMAGNETIC RESONANCE EXPERIMENTS ON CRYSTAL-ORIENTED HEXAGONAL FERRITES
Walter Viehmann 8 May 1964 22 p refs
(TR-1227; AD-601980)

Ferromagnetic resonance was measured on crystal-oriented samples of the $Co_\delta Ti_\delta M$ series prepared by means of "topotactical" reactions. Samples with a high degree of alignment were obtained with anisotropies ranging from +6,000 oe (uniaxial) to −4900 oe (planar). Resonance conditions can, in general, be described by existing theories, developed for single crystals of hexagonal crystal structure. Line-width measurements on these materials are also viewed in the light of existing theories. Author

N64-27949 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
QUARTZ CRYSTAL AGING EFFECTS Fourth Quarterly Report, 15 Nov. 1963–15 Feb. 1964
R. B. Belser and W. H. Hicklin 15 Feb. 1964 78 p refs
(Contract DA-36-039-AMC-02251(E))
(QR-4; AD-601678) OTS: $2.00

Aging measurements of quartz resonators of low frequency (100 kc, 250 kc, 455 kc, and 500 kc), 3 mc, 10 mc, and 16 mc and of various types of quartz were continued. The low-frequency and 10-mc units were examined for acceptance and reliability, and the 16-mc units were exposed to irradiation tests. The 3-mc resonators were examined for initial aging rate and for the aging rate at the end of 135 days. X-ray diffraction SID patterns were made of 20 units with several different reflections. These patterns continue to show a fairly high incidence of distortion, localized twinning, and surface and interior defects among completed resonators. The patterns were correlated, where possible, with frequency behavior. Mathematical expressions were derived for interpretation of the SID patterns in terms of the curvature and strain in the quartz crystal plates. Author

N64-27963 Physics International, Inc., Berkeley, Calif.
PREDICTION CALCULATIONS FOR FREE FIELD GROUND MOTION
Charles S. Godfrey, Dudley J. Andrews, and Ernest T. Trigg Kirtland AFB, N. Mex., AF Weapons Lab., May 1964 147 p refs
(Contract AF 29(601)-5832)
(WL-TDR-64-27; AD-601513)

This report describes a calculation program designed to predict the cratering dimensions and free-field ground motions that result when chemical or nuclear detonations occur with various degrees of confinement. Calculations were made using a two-dimensional plastic-elastic time-dependent code. A vital part of the program involved the derivation of calculational models capable of describing the response of earth media to shock loading. Author

N64-27989 Sperry Rand Research Center, Sudbury, Mass.
FLUORESCENT ION INTERACTION Final Report
William W. Holloway, Jr., and Michael Kestigian [1963] 64 p refs
(Contract Nonr-4127(00); ARPA Order 306-62; Proj. Defender)
(SRRC-RR-64-39; AD-440481)

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N64-27990 Sperry Rand Research Center, Sudbury, Mass.
FLUORESCENT ION INTERACTION
In its Fluorescent Ion Interaction Final Rept. [1963] 17 p refs (See N64-27989 20-25)

Two groups of experiments were conducted, depending on the ionic species; (1) the interaction between rare-earth ions, emphasizing both the energy exchange between rare-earth ions and the quenching of the fluorescence of one rare-earth ion by another; and (2) certain features of Mn^{2+} ion fluorescence, which are present in concentrated but not dilute manganese systems. Author

N64-27991 Sperry Rand Research Center, Sudbury, Mass.
DIRECT EVIDENCE FOR ENERGY TRANSFER BETWEEN RARE-EARTH IONS IN TERBIUM-EUROPIUM TUNGSTATES
William W. Holloway, Jr., Michael Kestigian, and R. Newman
In its Fluorescent Ion Interaction Final Rept. [1963] 7 p refs (See N64-27989 20-25)
(Contract Nonr-4127(00); Proj. Defender)

The transfer of excitation energy was observed from one species of rare-earth ion to another in terbium–europium tungstates of the general formula $(Tb_{1-x}Eu_x)_2(WO_4)_3$. The primary experiment consisted of the absorption of monochromatic light in a terbium absorption line (20.2×10^3 cm^{-1}) with a resulting emission of the red europium fluorescence (16.2×10^3 cm^{-1}). The details of this and other confirmatory experiments are described. Author

N64-27992 Sperry Rand Research Center, Sudbury, Mass.
THE TRANSFER OF ENERGY BETWEEN THE Sm^{3+}, Eu^{3+}, Tb^{3+}, AND Dy^{3+} IONS IN THE SODIUM RARE-EARTH TUNGSTATES

William W. Holloway, Jr. and Michael Kestigian *In its* Fluorescent Ion Interaction Final Rept. [1963] 11 p refs (See N64-27989 20-25)

Energy transfer was observed in crystal and powder samples of the sodium rare-earth tungstates containing two species of ions from the group Sm^{3+}, Eu^{3+}, Tb^{3+}, and Dy^{3+}. The observations may be classified into the following categories: energy transfer from Dy^{3+} to the Tb^{3+} ion; energy transfer from the Tb^{3+} to Sm^{3+}; energy transfer from the Tb^{3+} and Sm^{3+} to the Eu^{3+} ion. The energy transfer was determined, with the exception of the $Tb^{3+} \rightarrow Sm^{3+}$ case, by selectively exciting one species of ion and observing the fluorescence of the other ion. In the $Tb^{3+} \rightarrow Sm^{3+}$ case, the enhancement of the fluorescence from the Sm^{3+} was used to determine energy tranfer. Overlapping absorption lines prohibited selective excitation in this case. The $Dy^{3+} \rightarrow Sm^{3+}$ case and the $Dy^{3+} \rightarrow Eu^{3+}$ case are exceptional in that no strong fluorescence is observed.

Author

N64-27993 Sperry Rand Research Center, Sudbury, Mass.
ON THE RADIAL DEPENDENCE OF THE QUENCHING INTERACTION BETWEEN RARE-EARTH IONS
William W. Holloway, Jr., and Michael Kestigian *In its* Fluorescent Ion Interaction Final Rept. [1963] 9 p refs (See N64-27989 20-25)

The radial dependence of the quenching interaction between rare-earth ions has been studied through observation of the fluorescence lifetime as a function of concentration. The probability for quenching interaction P_{Int} was determined to be $P_{Int} \propto c^2$, where c is the concentration. The interaction was studied in solids for the selfquenching of the Nd^{3+} ions in $Na_{0.5}Y_{0.5-x}Nd_xWO_4$ and for the quenching of the Tb^{3+} fluorescence by Ho^{3+} ions in $Gd_{1-2x}Tb_xHo_xCl_3 \cdot 6H_2O$. The quenching of the Tb^{3+} fluorescence by Ho^{3+} in aqueous solutions of $Tb_{0.5}Ho_{0.5}Cl_3$, and the quenching of Tb^{3+} fluorescence by Nd^{3+} in aqueous solutions of $Tb_{0.5}Nd_{0.5}Cl_3$ were studied. The relation $P_{Int} \propto c^2 \propto 1/r^6$ may be interpreted as an indication of the dipole-dipole character of the interaction between the rare-earth ions. In all cases studied, the possibility of "resonant" transfer of energy exists.

Author

N64-27994 Sperry Rand Research Center, Sudbury, Mass.
THE EFFECT OF MAGNETIC ORDERING ON THE FLUORESCENCE OF MnF_2
William W. Holloway, Jr., and Michael Kestigian *In its* Fluorescent Ion Interaction Final Rept. [1963] 7 p refs (See N64-27989 20-25)

Observations are reported of alterations in the fluorescence of MnF_2 that appear to be related to the magnetic ordering at the Néel temperature of the material. The change in the fluorescence attributed to this magnetic ordering is illustrated in graphic form.

I.v.L.

N64-27995 Sperry Rand Research Center, Sudbury, Mass.
ON THE FLUORESCENCE OF CONCENTRATED MANGANESE SYSTEM. I: THE FLUORESCENCE OF MnF_2 AND THE ALKALI MANGANESE TRIFLUORIDES
William W. Holloway, Jr., and Michael Kestigian *In its* Fluorescent Ion Interaction Final Rept. [1963] 11 p refs (See N64-27989 20-25)

The wavelength, lifetime, and relative intensity of the fluorescences of crystal samples of MnF_2 and the alkali manganese trifluorides were measured as a function of temperature above 21° K. In the vicinity of the Néel temperature small changes in the fluorescent properties are observed in all samples. These effects can be attributed to the additional lattice distortion near an excited Mn^{2+} ion due to the changing magnetic environment. At lower temperatures, larger changes are observed in the fluorescence of these materials. The changes may be due to magnetic ordering of the Mn^{2+} excited state.

Author

N64-28094* New York U., N.Y.
PARAMAGNETIC RESONANCE OF TRANSITION ELEMENTS AND IRRADIATED SUBSTANCES
R. C. Sahni Repr. from Symp. on Chem. and Phys. Effect of High Energy Radiation on Inorg. Substances, Am. Soc. for Testing and Mater., 1964, no. 359 p 20–37 refs Spec. Tech. Publ.
(Grant NsG-76)

The application of electron paramagnetic resonance (EPR) spectra to well-defined systems containing unpaired electron spins such as transition metals, ions located in crystal lattice, and certain odd electron systems is discussed. Special problems such as resonance from free radicals, conduction electrons in metals and semiconductors, broken bonds, and irradiated substances are also considered. In the study of radiated substance, discussions are centered on crystals and on the dislocation and imperfections that are produced in them by radiation damage. The paramagnetic resonance study of irradiated substances is shown to give qualitative information on the nature of crystal imperfection, as well as a quantitative estimate of the number of damage centers.

Author

N64-28144 Spectrolab, Inc., Sylmar, Calif.
DESIGN AND FABRICATION OF OPTICAL FILTERS FOR LASER FREQUENCY Quarterly Progress Report No. 2, 10 May–9 Aug. 1963
Samuel J. Holmes and Noel Bowman 29 Aug. 1963 14p
(Contract AF 33(657)-9216)
(QPR-2; AD-419554)

The spectral transmission of Indian ruby and of Indian clear-green mica is presented. The Indian ruby mica cleaves with good uniformity and flatness, but the absorption factor significantly limits the transmission efficiency of the mica filter. The Indian clear-green mica shows far less absorption than the Indian ruby mica, but does not cleave with the relatively large uniformity areas as desired. Some promising results were obtained in an experimental effort to reduce the absorption of the Indian ruby mica.

R.T.K.

N64-28196 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, 1–31, Jan. 1964
Z. Szepesi, W. A. Thornton, and R. E. W. Lake 25 Feb. 1964 6 p
(Contract N61339-1440)
(MTER-7; AD-604742)

The effect of different plastic materials on the characteristics, and chiefly on the capacitance of PC layers was studied. The effect of the substrate material was investigated also. Several batches of PC powders were prepared, and some image intensifier panels were fabricated. A simple light-meter, using a linear (current vs light intensity) CdS PC cell, for the easy measurement of light intensities and brightnesses, was constructed and delivered. In the evaporated EL film program, the effect of an insulating film on either or both sides of the EL film was studied.

Author

N64-28197 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, 1–29, Feb. 1964

D. C. Fowlis, R. D. Harder, R. E. W. Lake, Z. Szepesi, W. A. Thornton, et al 13 Mar. 1964 7 p
(Contract N61339-1440)
(MTER-8; AD-604745)

Work has been started in purifying the best commercially available CdSe powder, and in studying the effect of Zn impurities on the photoelectronic characteristics of sintered CdSe layers. A literature search is being made on other new PC materials for possible use in the PC–EL image intensifiers. An effort has been made to diminish the high noise level in the Hall-effect measuring device. Several batches of CdSe PC powders have been made. The effect of copper and oxygen acceptor concentration has been studied in these powders. Evaporated EL films have been studied with MgF_2 insulating layers above and/or below the EL films. Life tests on differently prepared EL films did not show any useful improvement. Author

N64-28198 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, 1–31, Mar. 1964
D. C. Fowlis, R. D. Harder, R. E. W. Lake, Z. Szepesi, W. A. Thornton et al 13 Apr. 1964 8 p
(Contract N61339-1440)
(MTER-9; AD-604743)

A small amount of CdSe powder was purified by a sublimation method. Chemical analysis of the purified powder is being made. Studying the effects of Zn impurities on the photoelectronic characteristics of CdSe sintered PC cells ended with the conclusion that Zn is an undesirable impurity. Work with ZnSe has been started; no success was achieved in either sintering or sensitization of this powder. Hall-effect measurements were made with improved signal-to-noise ratio. In the PC powder program, the effect of oxygen and of halogens was studied. Additional green-emitting EL films were made, because they show about 10 times higher efficiency than yellow films. Characteristics of EL films and sintered CdSe PC elements and of their combination in a light amplifier were measured and analyzed. Author

N64-28199 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, 1–30, Apr. 1964
D. C. Fowlis, R. D. Harder, R. E. W. Lake, Z. Szepesi, W. A. Thornton, et al 13 May 1964 10 p
(Contract N61339-1440)
(MTER-10; AD-604744)

Spectral analysis of CdSe powders, purified by sublimation, shows some improvement, but probably purer material can be obtained by improving the condition under which the material is prepared and by more careful handling of the material. A small amount of CdSe was prepared by synthesizing it from very pure Cd and Se. The same comments apply for this method as for the sublimation. Experiments with ZnSe did not show good sintering. Oxide impurities in the powder are suspected; purification by the sublimation method is being prepared. Work was started in developing a better deposition method for the PC layer. Several series of experiments for the preparation of PC powders were made, but sensitivities obtained by the described method are still many orders of magnitude lower than required. Regarding EL films, improvements in tin oxide coating and in the preparation of larger size (6- × 6-in.) panels have been made. Some small-size image intensifiers were made by depositing highly sensitive PC powder on EL films. Gains around unity were measured. Author

N64-28211* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SURVEY OF THE LITERATURE ON NONMAGNETIC MATERIALS FOR USE IN SPACECRAFT
J. B. Crooks *In its* Goddard Summary Workshop Program in Meas. and Simulation of the Space Environ. [1963] 46 p refs (See N64-28201 20-23) OTS: $19.75 ph

A partially annotated bibliography is presented that represents a literature survey of possible nonmagnetic materials for use in spacecraft or in other aerospace applications. Topics included in the bibliography are these: (1) weakly magnetic materials; (2) the susceptibility of organic compounds; (3) ferromagnetism and antiferromagnetism in nonferrous alloys; (4) "completely" nonmagnetic alloys; and (5) the mechanical and physical properties of nonferrous metals and plastics. I.v.L.

N64-28212* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TESTING OF NONMAGNETIC MATERIALS
E. Levy *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 8 p refs (See N64-28201 20-23) OTS: $19.75 ph

This report describes work performed at the Goddard Space Flight Center on methods of measuring the magnetic properties of "nonmagnetic" materials in low magnetic fields (0.5 gauss). The work deals mainly with the setting up of apparatus required for the following test methods: (1) the force methods; (2) the a.c. induction method; and (3) the d.c. induction method. Before actual experimentation began, a literature survey of various test methods was conducted. This survey indicated that test methods II and III were feasible. A bibliography resulting from the survey is presented. I.v.L.

N64-28218* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METAL WHISKERS
John A. Anderson *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 7 p refs (See N64-28201 20-23) OTS: $19.75 ph

A general discussion of metal whiskers is presented. Subjects discussed include induced growth; mechanisms for growth; energy sources for growth; properties of whiskers; magnetic properties of whiskers; uses of whiskers; and effects of radiation on whiskers. P.V.E.

N64-28219* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL METHOD FOR OBSERVING TRANSITION GROWTH OF GRAPHITE WHISKERS
J. M. Canter and R. B. Heller *In its* Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 4 p refs (See N64-28201 20-23) OTS: $19.75 ph

An experimental method for observing the transition growth of graphite whiskers is described. An electric arc is passed through a selected graphite filament. The hydrocarbon atmosphere in the immediate vicinity of constriction (perhaps chosen to contain a whisker) is broken down and the carbon atoms deposit on both the whisker and its surroundings. It is anticipated that the pressure and temperature required for whisker growth will be critical; the optimum conditions must be determined experimentally. Once determined, observation of crystal growth may be made. This requires ultra-high-speed photography. The magnification required is 1,000x. At these

high powers, only a laser beam can supply sufficient intensity for adequate illumination. The ultra-high-speed cinemicrography is described in the appendix. I.v.L.

N64-28224 Microwave Electronics Corp., Palo Alto, Calif.
STUDY OF MICROWAVE GENERATION UTILIZING DOUBLE-STREAM INSTABILITIES IN ANISOTROPIC MEDIA 1 Feb.–30 Apr. 1964
F. A. Olson and L. D. Buchmiller [1964] 30 p refs
(Contract DA-36-039-AMC-03424(E))
(QPR-2; AD-444943)

Methods of obtaining large carrier drift velocities in pyrolytic graphite are considered. In particular, the configuration using crossed electric and magnetic fields with the magnetic field in the c-direction is of interest. This configuration causes both the electrons and the holes to drift in the same direction, and increases the resistance of the sample so that the contact and series resistance problems are decreased. An approximate analysis using the double-stream amplifier analogy indicates that oscillations are possible for the crossed-field case. Measurements of resistivity and magnetoresistivity indicate that the new pyrolytic graphite samples annealed at 2,750° and 3,000° C are satisfactory. Preliminary measurements using a pulsed technique to observe nonohmic behavior in pyrolytic graphite have been started. Author

N64-28283 Eastman Kodak Co., Rochester, N.Y. Apparatus and Optical Div.
LASER MATERIALS STUDY Semi-Annual Technical Report, 1 Jul.–31 Dec. 1963
P. B. Mauer [1963] 6 p
(Contract NONr-3834(00); Proj. Defender)
(AD-442059)

Considerable time was spent in adapting the glass-plant procedures to handle silicated glass formulations of a sufficient size to give good optical quality. The in-house capability to provide a low-melting lithium silicate glass as a second comparison for the standard borate material was extended. This glass was cast, annealed, ground and polished, but it was not coated and tested. R.T.K.

N64-28526 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
REFLECTIVE TYPE LASER AMPLIFIER
H. Jacobs, D. A. Holmes, L. Hatkin, and F. A. Brand Jun. 1964 21 p
(TR-2467; AD-604100)

Calculations were carried out in an analysis of a reflection-type laser amplifier. Electromagnetic radiation is assumed to travel at normal incidence through a system composed of air, a partially transmitting silver reflector, active media such as ruby, and a thick silver reflector. The analysis is facilitated by considering the ruby as a medium with an effective negative conductivity resulting in the growth of the wave during propagation. Highest gains are obtained with the front mirror completely removed, since losses resulting from a skin effect mechanism cut down the useful power output. In the system consisting of air, ruby, and metal, the presence of the rear metal reflector decreases the angle required for maximum gain to almost half the value required for a completely transmitting system consisting of air, ruby, and air. Author

N64-28528 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
IDENTITY PERIOD OF THE LATTICE AND MICROHARDNESS OF SOLID SOLUTIONS OF INDIUM AND GALLIUM PHOSPHIDES
N. N. Sirota and V. V. Rosov 11 Jun. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk BSSR (Minsk), v. 7, No. 7, 1963 p 446–448
(FTD-TT-64-151/1+2; AD-602311)

The synthesis of the compounds InP and GaP and their solid solutions was accomplished by the method of saturation with phosphorous from the vapor-phase fusions of indium and gallium of given compositions. The synthesis is accomplished with simultaneous zone equalization in a two-zone furnace. Metallographic analysis of the alloys obtained showed that in the whole range of concentrations, single-phase crystals were obtained of the solid solutions InP–GaP. The X-ray analysis revealed only one system of distinct lines from which the lattice constant was determined at 0.01 A. Microhardness was measured and found to be about 540 kg/mm^2 for indium phosphide and about 850 kg/mm^2 for gallium phosphide. In the area of high temperatures, there exists a continuous series of solid solutions of InP and GaP with which the constant of the lattice changes additively with the concentration of GaP. E.K.R.

N64-28537 Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
SPECTRA AND EVERY LEVELS OF Eu^{3+} IN Y_2O_3
N. C. Chang and J. B. Gruber (California U.) 13 Jul. 1964 32 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-113; TDR-269(4250-25)-1; AD-603978)

The absorption and fluorescence spectra of Eu^{3+} in single crystals of Y_2O_3 were observed and analyzed. The intermediate-coupling free-ion energy levels for Eu^{3+}, including the effects of the 46 singlet states, are presented for all levels appearing below 41,000 cm^{-1}. The results obtained by including the singlet states in the free-ion energy level calculations are discussed. Author

N64-28550 Hughes Research Labs., Malibu, Calif.
LASER DEVICES EXPLORATORY INVESTIGATION Interim Engineering Report, 1 May 1964–31 Jul. 1964
H. V. Winston [1964] 28 p refs
(Contract AF 33(657)-11650)
(IER-5; AD-604038)

Quarter-wave plates for a longitudinal mode selector were completed. Evaluation of a liquid-nitrogen-cooled pumping configuration for ruby showed that the overall efficiency is lower than for a room-temperature system despite a 40% lowering of threshold. Therefore, attention was given to the further improvement of noncryogenic systems, including the effects of multiple ellipse cavities, improved optical finish, and cooling to 0° C. The efficiencies of several useful linear flash lamps were measured. Equipment for the growth of yttrium oxide was modified and is ready for operation. Doped lanthanum fluoride of excellent optical quality was prepared and used for optical and microwave studies. Improvements in the mode control of giant pulse lasers have resulted in significant changes in the anti-Stokes emission in benzene; when produced by essentially single-mode ruby radiation, the anti-Stokes line is sharp in wavelength and angle, and the angle corresponds to the requirements of index matching. Thresholds and conversion efficiencies for the production of stimulated Raman scattering were measured, and the production of damage in transparent dielectric materials was investigated. Author

N64-28552 Group for the Advancement of Spectroscopic Methods, Paris (France)
FAR INFRARED SPECTRA OF CRYSTALS AND SOLIDS IN A LARGE RANGE OF TEMPERATURES Annual Summary Report No. 2, 30 Apr. 1963–30 Apr. 1964

J. Lecomte (Centre Natl. de la Rech. Sci.) and A. Hadni (Nancy U.) 15 May 1964 16 p refs
(Contract AF 61(052)-518)
(AFCRL-64-489; AD-603039)

Instrumentation techniques and improved efficiency in detectors are discussed. The far infrared spectra are given for single crystals of the following: diamond, ruby, cuprous halides, cuprite, alkali halides, thallium halides, and glasses. J.L.C.

N64-28560 Louvain U. (Belgium) Lab. de Chimie Physique
PHOTO-MAGNETO-ELECTRIC STUDY OF CdS SINGLE CRYSTALS. TRANSPORT PROPERTIES OF BISMUTH ROLLED THIN FOILS Final Scientific Report, 15 Nov. 1958–31 Dec. 1963
André Luyckx, Jean Vandewauwer, Jean-Paul Issi, Guy Lontie, Jacques Stoquart et al. Apr. 1964 83 p refs
(Contract AF 61(052)-166)
(RADC-TDR-64-349; AD-603490)

Photo-magneto-electric phenomena in CdS single crystals are interpreted by photopolarization. High-frequency forming of CdS is interpreted by solid reversible electrolysis. Photovoltages and adsorbed gases are discussed. Photocurrents induced by postirradiation infrared quenching wavelengths are studied. Transport properties of bismuth rolled thin foils at 80° and 295° K, resistivity, thermoelectric power, magnetoresistance, Hall constant, and magneto-Seebeck coefficient are compared with the similar properties of undeformed samples. Author

N64-28561 Louvain U. (Belgium) Lab. De Chimie Physique
PHOTOCONDUCTIVITY OF CdS EXCITED by QUENCHING INFRARED RADIATION Scientific Report No. 11
Jean-Pierre Michewaud and Andre Luyckx Jun. 1964 15 p refs
(Contract AF 61(052)-776)
(RADC-TDR-64-379; AD-603491)

Some CdS photoconductive single crystals, with high dark resistivity, have been irradiated at room temperature with 6,900 A and 9,000 A, both simultaneously and successively. It was found that postirradiation by 9,000 A generates a photocurrent that lasts about five seconds, although this infrared radiation quenches the photocurrent during simultaneous irradiation. It is suggested that infrared photoconductivity is connected with the transition of electrons to the conduction band from deep acceptor levels. A model is proposed for the interpretation of several experimental results. Author

N64-28573 IIT Research Inst., Chicago, Ill.
REFRACTORY INORGANIC NONMETALLIC MATERIALS, THEORY AND MECHANICAL PHENOMENA Technical Documentary Report, Apr. 1, 1963–Mar. 31, 1964
P. D. Southgate and K. S. Mendelson Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 81 p refs
(Contract AF 33(616)-8132)
(ASD-TDR-431, Pt. III; AD-601991)

Internal friction in plastically deformed silicon and indium antimonide single crystals is measured in the 400 c/s to 80 kc/s region, at temperatures up to 1,200° C. The internal friction vs temperature curves are tentatively analyzed into two overlapping parts, a Bordoni peak and a high temperature rise. The Bordoni peak was previously predicted, and the lower temperature portion ascribed to motion of discrete built-in kinks in the dislocation. In silicon the activation energy of this process is 1.6 ev, and in indium antimonide, of the order of 0.42 ev. Extension to lower frequencies, using a tuning-fork specimen, now allows the peak to be resolved, the mean free dislocation length corresponding to the peak height normally being of the order of 5×10^{-5}cm. The high temperature rise is interpreted as a result of thermal broadening of the core, allowing breakaway of the dislocation and a subsequently more rapid increase of damping with temperature. The magnitude of the internal friction in this region is consistent, in silicon, with viscous behavior of the dislocation core material. In indium antimonide, the temperature dependence of core viscosity derived from this model is anomalous, and it is evident that a modified interpretation of the data is required. Author

N64-28577 National Co., Inc., Malden, Mass.
INVESTIGATION OF MULTIPLE SPIN FLIP PROCESSES TO PRODUCE TRANSITIONS AND INVERSIONS AT ARBITRARY FREQUENCIES Final Report
George W. Myers 16 Mar. 1964 72 p refs
(Contract AF 19(628)-456)
(AFCRL-64-243; AD-603553)

The rate equations governing the operation of a six-level maser using cross relaxations between the three pairs of spin levels in phosphorous-boron doped silicon are derived. Excess populations are obtained under the assumption that the longitudinal relaxation time for electrons in boron states is much shorter than that for electrons in phosphorous states, in terms of a cross relaxation time τ_x and the longitudinal times τ_1. Dependence of τ_x on concentrations, and minimal conditions for inversion, are established. The criteria for the design and operation of a dual-mode spectrometer to be used to measure τ_x and as a maser, are established in terms of microwave parameters and spin system-crystal parameters. Estimates of the operating values are made by taking reasonable values for the parameters. The final design and operation of the spectrometer are described. The effects of cavity loading are estimated in terms of the cavity mode and crystal lossiness, and are compared to the experimental practice. Sensitivity of the spectrometer and experimental results are given. Author

N64-28579 General Electric Co., Schenectady, N.Y. Research Lab.
SEMICONDUCTOR DEVICE CONCEPTS Scientific Report No. 7
H. H. Woodbury, M. Aven, F. K. Heumann, and R. N. Hall 5 May 1964 61 p refs
(Contract AF 19(628)-329)
(AFCRL-64-467; AD-603783)

Studies of the defect chemistry of the II to VI compounds were continued, and a comparison is made of the electrical behavior of CdTe, CdS, and ZnSe following either thermal firings or 1.5 Mev electron bombardment. A common double-acceptor center is identified and is postulated to be an anion vacancy-halogen impurity complex. The diffusion of Cu into undoped ZnS as well as Cl-doped and Al-doped ZnSe was investigated by radiotracer techniques. The results were used to correlate the electrical and optical activity of some defect centers in II to VI compounds. The implication of the findings on the mechanism of electron-hole recombination in ZnSe-Cu_2Se heterojunctions was discussed. The halogen transport growth of $GaAs_xP_{1-x}$ crystals continued. Laser quality material is being produced, but the ingots, while relatively homogeneous, are polycrystalline. Several ingots of GaAs and $GaAs_xP_{1-x}$ were made using a lower furnace temperature. These ingots have large single-crystal regions and are more homogeneously doped than previous ones. Exciton and related luminescence phenomena that occur near the band edge of a semiconductor are discussed and compared with the absorption spectrum. Author

N64-28603 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
PERFORMANCE DATA ON FILTER CRYSTALS (1.75 Mc)
Arthur D. Ballato Nov. 1963 31 p refs
(USAELRDL-2443; AD-603348)

The frequency of 1.75 mc was used in connection with the development of equipment for single sideband purposes, for example, front-end filters. The purpose of this report is to give a compilation of representative data on filter crystals operating in the vicinity of 1.75 mc, obtained both at USAELRDL and by various contractors. Author

N64-28622 Duke U., Durham, N.C.
NUCLEAR MAGNETIC RESONANCE IN SOLID H_2 and D_2 UNDER HIGH PRESSURES
Samuel A. Dickson and Horst Meyer [1962] 47 p refs Submitted for Publication
(Contract Nonr-1181(12))
(TR-3; AD-601933)

Nuclear magnetic resonance data are presented for solid H_2 and D_2 between 1.5° and 4.2° K and at pressures up to 5,500 atm. For solid hydrogen, the ortho–para conversion, the transition temperature T_λ from the state of free rotation to that of hindered rotation, and the linewidth and second moment above T_λ have been measured as a function of density ρ and ortho concentration. The ortho–para conversion rate is approximately proportional to $\rho^{2.4}$, and the transition temperature T_λ for a given ortho concentration is roughly proportional to $\rho^{2.0}$ Author

N64-28623 Stanford Research Inst., Menlo Park, Calif.
FUNDAMENTAL RESEARCH IN SUPPORT OF VELAUNIFORM Final Report
George Duvall and Roy C. Alverson 31 May 1964 161 p refs
(Contract AF 49(638)-1086; ARPA Order 180-61)
(AD-442254)

The following are discussed: Thermodynamics of Unaxial Compression in an Elastic-Plastic Solid—Stress Relaxation in Quartzite Derived from Shock-Wave Measurements, Plane and Spherical Waves in a Compressible Plastic-Relaxing Medium, Spherical Waves in an Incompressible Plastic-Relaxing Medium, and Measurements of Compression Modulus in Uniaxial Strain; and Spherical Waves in Elastic-Plastic Media—Time Derivatives of Discontinuities of a Function, Propagation of Discontinuities in Elastic Media, Propagation of Discontinuities in Elastic-Plastic Media, Numerical Computation in Elastic Media, and Numerical Computation in Elastic-Plastic Media. R.T.K.

N64-28645 Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
DEVELOPMENT OF MILLIMETER AND SUBMILLIMETER MASER DEVICES Interim Technical Report, 1 Feb.–31 May 1964
W. E. Hughes [1964] 20 p ref
(Contract AF 33(657)-10472)
(ITR-4; AD-602019)

A zero-magnetic-field maser was operated at a frequency of 81.3 Gc with the iron ion in rutile; a zero-magnetic-field maser was operated at a frequency of 78 Gc with the iron ion in zinc tungstate, and the first reported paramagnetic resonance absorption was observed at frequencies near 330 Gc with the manganese ion Mn^{3+} in rutile. Author

N64-28650* Rensselaer Polytechnic Inst., Troy, N.Y.
POLYMER MICROSCOPY
P. Sullivan and B. Wunderlich Repr. from Polymer Letters, v. 2, 1964 p 537–540 refs
(Grant NsG-(T)-10)

Recently, it was reported that polyethylene single crystals deposited onto a reflecting substrate were not detected using an incident light microscope. This paper shows that such crystals are observable under the above conditions with or without the use of an interferometer. The cases in which either the top or the bottom surface of the crystal has been silvered are considered. Author

N64-28667 Services Electronics Research Lab., Baldock (Gt. Brit.)
THEORY OF ENERGY LEVELS OF TRANSITION METAL IMPURITIES IN SEMICONDUCTORS
J. W. Allen Jul. 1964 14 p refs In S.E.R.L. Tech. J., v. 14, no. 2 Presented at the Intern. Conf. on Semicond., Paris, Jul. 1964

A semiempirical method is presented for calculating the energy levels of deep-lying impurities in semiconductors when an incomplete atomic shell is involved, as in the transition metals and the rare earths. The ionization energy is assumed to contain a term linear in the number of electrons in the shell, together with other terms arising from electron–electron, crystal field, and spin-orbit interactions. These various terms can be expressed approximately as functions of a few parameters that may be determined empirically. The application of the theory to third impurities in ZnS is considered. Author

N64-28678 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
500° C SILICON CARBIDE RECTIFIER PROGRAM Interim Technical Progress Report No. 10, 1 Jan.–31 Mar. 1964
H. C. Chang, D. R. Thornburg, C. J. Roach, J. Ostroski, D. L. Barrett et al Wright-Patterson AFB, Ohio, ASD [1964] 23 p
(Contract AF 33(657)-7027)
(ASD-IR-7-727-10; AD-601008)

The pilot line is now being constructed, and the various stations are described in this report. The design of the new sublimation furnace was completed and fabricated. Further development work is being carried out on crystal growth. With the addition of graphite felt to the furnace as an insulating material, pump down time was materially reduced. Progress is being made on the solid doping technique for aluminum, and p on n type junctions are being grown. Author

N64-28713 Stanford U., Calif. Microwave Lab.
FINAL PRECESSION ANGLES FOR PULSED FERRITE SAMPLES
K. J. Harker Apr. 1964 18 p refs
(Contract DA-36-039-AMC-00041(E))
(ML-1149; AD-602035) OTS: $0.50

A theoretical study has been made of the transient motion of the magnetization vector in isotropic ferrite spheres during the application of pulsed magnetic fields at an angle to the d.c. saturating field. Results are presented that permit the determination of the final precession angle for arbitrary pulse rise rates and pulsing angles when the pulse is linear, and for arbitrary pulsing angles when the pulse is slowly rising and nonlinear. Author

N64-28727 Argonne National Lab., Ill. Metallurgy Div.
A SEMINAR ON GROUPS V AND VI ANIONS
R. J. Beals, J. H. Handwerk, and J. F. Schumar Mar. 1964 55 p refs Seminar Held 26–27 Feb. 1964; Sponsored Jointly by Argonne Natl. Lab. and The Assoc. Midwest Univ.
(Contract W-31-109-eng-38)
(ANL-6856) OTS: $1.25

Résumés are given of the addresses presented at a seminar on Groups V and VI anions. The seminar was limited to information on the current status of effort in investigations of the chalcogenides (sulfides, selenides, and tellurides) and pnictides (nitrides, phosphides, arsenides, and antimonides) on which little information was available in the literature. Topics of the various sessions included thermodynamic properties, structure and phase relations, mechanical and transport properties, and magnetic and transport properties. M.P.G.

N64-28738 California U., Livermore Lawrence Radiation Lab.
THE DIFFUSION OF NONVOLATILE METALLIC ELEMENTS IN GRAPHITE
J. R. Wolf, D. R. Mc Kenzie, and R. J. Borg 29 Apr. 1965 64 p refs
(Contract W-7405-ENG-48)
(UCRL-7324) OTS: $1.75

The diffusion coefficients for Ag, Ni, U, Th, and Ra diffusing in various types of graphite were determined as a function of temperature. Good precision is obtained in all cases, and the corresponding activation energies are reported. These values, when comparison is possible, do not agree with values previously reported. An explanation is given for the discrepancy based upon the relative insolubility of metals in graphite. Experimental evidence is presented that indicates that substitutional, pore, and interstitial diffusion are negligible and that all mass transport proceeds via grain and subgrain boundaries. Author

N64-28739 California U., Livermore Lawrence Radiation Lab.
RADIATION EFFECTS ON NOBLE METALS Bibliography
Brigitta M. Dobratz 14 Apr. 1964 33 p
(Contract W-7405-ENG-48)
(UCRL-7810) OTS: $0.75

N64-28754* Rice U., Houston, Tex.
ZEEMAN EFFECT AND RUBY LASER POLARIZATION
A. S. Badger and T. A. Rabson [1964] 7 p refs Submitted for Publication
(Grant NsG-6-59)
(NASA-CR-58358) OTS: $1.10 ph

An investigation of the possibility of accomplishing polarization control in a solid-state laser by subjecting the lasing medium to a controllable magnetic field is reported. The results showed no change in the polarization of the output of a ruby laser for uniform fields perpendicular to the axis of the laser with magnitudes up to 8,000 gauss for either the 0° rod or the 90° rod. The effect of magnetic fields on the microwave beats in the output of a ruby laser was also investigated. The only reproducible effect observed was that the amplitude of the microwave beating was considerably reduced by the application of a magnetic field of sufficient intensity to counteract the magnetic field produced by the exciting current in the linear flash tube. Work is continuing on other solid-state materials not having a powerful crystal field as does ruby. M.P.G.

N64-28765 Northwestern U., Evanston, Ill.
MATERIALS RESEARCH CENTER 1963–64 ANNUAL REPORT Fourth Annual Report, 1 May 1963–31 Jan. 1964
[1964] 118 p refs
(ARPA SD-67)
(AR-4; AD-602012)

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27. SOLID STATE NUCLEAR RESONANCE STUDIES D. S. Schreiber p 112
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N64-28790* Stanford U., Calif. Electron Devices Lab.
OPTICAL SECOND-HARMONIC GENERATION IN SEMICONDUCTOR ALLOYS Interim Report
R. A. Soref Dec. 1963 100 p refs
(Grant NsG-331; Contract AF 33(657)-11144)
(TR-0556-9; SU-SEL-63-145; AL-TDR-64-78; AD-602212)

Optical second-harmonic generation in semiconductors was studied experimentally and theoretically to learn how energy-band structure and lattice symmetry influence the efficiency of harmonic conversion. Using a pulsed Nd^{+3}:glass laser, harmonic generation was measured as a function of alloy composition in wurtzite ZnS-CdS and CdS-CdSe monocrystals to determine the effect of setting the energy gap E_g at values either greater or less than the harmonic photon energy $2\hbar\omega$. In experimental studies of the variation of the macroscopic second-order electric susceptibilities with alloy composition, it was found that the susceptibility X_{33} increased steadily (by about one order of magnitude) as E_g was decreased from 1.52 to 0.73 ($2\hbar\omega$). The influence of lattice symmetry was investigated by comparing harmonic generation in zinc-blend and wurtzite semiconductors having similar energy gaps, namely ZnSe, ZnTe, GaP, GaAs, CdS, CdSe, cubic ZnS, and hexagonal ZnS. Relative numerical values of X_{36} in the zinc-blend materials and X_{33} in the wurtzite material were deduced from measurements made with polarized laser light. It was found that the lattice structure has less effect upon the magnitude of these susceptibility-tensor components than the band structure. I.v.L.

N64-28792 Johns Hopkins U., Baltimore, Md. Carlyle Barton Lab.
MEASUREMENT OF RELAXATION-TIMES OF PARAMAGNETIC IONS IN CRYSTALS: RUBY
G. C. Brown, Jr. Jun. 1964 39 p refs
(Contract AF 33(657)-11029)
(AF-111; AD-602186)

The experimental methods of measuring relaxation times (radiative and nonradiative) of the excited states of paramagnetic ions in crystals are described. In particular, various methods of excitation and detection of fluorescence radiation, when short lifetimes and/or weak fluorescence are involved, are discussed in some detail. Explicit solutions of the rate equations for a simple 3-level system are obtained to clarify the effects of the shape of the fluorescence excitation pulse on the fluorescence radiation that is observed. These results, applied to some fluorescence decay data on Pr^{3+} in $LaCl_3$, lead to a relaxation time at 300° K of 0.27 μsec for the transition $^3P_2 \rightarrow {}^3P_0$. The fluorescence lifetimes of the R-lines of ruby have been measured at 77° K and 297° K over a wide range of Cr^{3+} concentrations (0.004% to 2.5%). Extrapolation of the data to concentrations of the order of 0.002% indicates that the R-line lifetimes would then be nearly temperature independent. Author

N64-28808 Brookhaven National Lab., Upton, N.Y.
GRAPE. A COMPUTER PROGRAM FOR CLASSICAL MANY-BODY PROBLEMS IN RADIATION DAMAGE
Arlene Larsen Jan. 1964 285 p refs
(Sponsored by AEC)
(BNL-7979)

GRAPE is a series of 7090/7094 programs, FORTRAN and FAP, for solving the classical equations of motion of a large set of particles. The primary purpose is to simulate the motion of atoms in a crystal. Part I sets up the crystal configuration, calculates entries for various tables needed in other parts, and saves this information on a binary tape. Part II integrates the classical equations of motion, checks that energy conservation laws have held, and writes information on a binary tape. Part III edits the binary tape for desired information, performs additional calculations as needed, and writes output. Part IV contains utility routines for manipulating and identifying tapes and making some ancillary calculations. Author

N64-28821 Alfred U., N.Y.
STUDY OF PHOTOCONDUCTIVITY IN POLYCRYSTALLINE CADMIUM TELLURIDE
George Thompson Lewis (Ph.D. Thesis) May 1964 105 p refs
(Contracts AF 33(657)-9454; Nonr-1503(01))
(AD-601800)

Polycrystalline samples of cadmium telluride were hot pressed from high-purity materials over a range of temperature at 3,000 and 30,000 psi. Studies of the specimens were made in terms of their photoconducting properties, infrared transmission, resistivity, and carrier lifetimes. High-pressure-formed CdTe materials were found to approach single crystal properties for photoconductor and infrared transmission applications. Author

N64-28828 Pennsylvania State U., University Park
EFFECT OF RADIATION ON DYNAMIC PROPERTIES OF HIGH POLYMERS Progress Report, Jun. 1963–Jun. 1964
A. E. Woodward Jun. 1964 10 p
(Contract AT(30-1)-1858)

Recently completed experimental studies are described including proton magnetic resonance, dielectric, thermal expansion, and dynamic mechanical investigations on a variety of polymers in the solid state at temperatures as low as 4.2° K, in addition to dielectric studies of copolymers in solution. Author

N64-28835* General Dynamics/Electronics, Rochester, N.Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report, 17 Jul.–31 Jul. 1964
E. G. Brock, F. C. Unterleitner, Y. C. Kiang, and J. F. Stephany 10 Aug. 1964 9 p
(Contract NASw-1008)
(NASA-CR-58627; MR-1) OTS: $1.10 ph

This report describes the effort devoted to preparations for the experimental determination of the absolute value of optical gain in ruby lasers as a function of inhomogeneous magnetic-field intensity. The approach that was chosen for measuring the dependence of gain on the magnetic field uses the threshold for laser oscillation as the criterion for showing that a gain sufficient to overcome cavity losses has been achieved. The cavity in which the laser crystal is optically pumped and subjected to a magnetic field, the optical bench for making the transmission measurements, and the positioning of the collimated probe beam are described. Electronic circuitry permits the magnetic field and the flash lamp and probing lamp of the optical bench to be pulsed in the desired frequency. I.v.L.

N64-28843* National Beryllia Corp., Haskell, N.J.
STUDY OF IMPROVED BERYLLIUM OXIDE MATERIALS FOR MICROELECTRONICS TECHNOLOGY Final Report, 8 Apr. 1963–8 Dec. 1963

31 Dec. 1963 60 p refs
(Contract NASw-685)
(NASA-CR-58527) OTS: $5.60 ph

Hexagonal-shaped platelets of monocrystalline BeO have been produced, mainly by the water-vapor transport method, in sizes up to 0.175-in. diam, with average diameters of 0.050 to 0.060 in. Chemical purity of these crystals has been very high, with most of the impurities concentrated at the surfaces. High levels of purity have also been maintained on monocrystalline products of the evaporation-condensation and molten salts techniques. Dielectric, optical, and thermal properties of single crystals of BeO have been measured, and results correlated with crystal structure. Results of experimental work have shown strong indications that monocrystalline BeO exhibits many characteristics, both physical and mechanical, which make the material far more attractive than the polycrystalline variety. Author

N64-28863 Galileo Ferraris National Electrotechnical Institute, Turin (Italy)

ON THE INFLUENCE OF SMALL AMOUNTS OF IMPURITIES ON RECRYSTALLIZATION AND GRAIN GROWTH OF HIGH PURITY IRON. NOTE III: EFFECT OF BORON ON RECRYSTALLIZATION AND EFFECT OF IMPURITIES ON NORMAL AND ANOMALOUS GRAIN GROWTH Final Technical Report, 1 Oct. 1962–29 Feb. 1964

G. Venturello, F. Bonaccorso, G. Della Gatta, and A. Lucci Mar. 1964 97 p refs
(Contract DA-91-591-EUC-2708-01-360165-D)
(AD-602137)

The effect of boron and silicon on the recovery and recrystallization of pure iron and the effect of precipitated impurities and of medium and low amounts of strain on the grain growth of pure iron were investigated. Specimens of Fe-B alloys, free from silicon, did not show any effect of boron on the recovery and recrystallization of pure iron. Only an increased nucleation rate, caused by precipitated Fe_2B, was observed. A 0.16 wt % content of silicon delayed the recovery and recrystallization temperature of pure iron by 110° C and 40° C, respectively. Medium amounts of strain (25% to 40%) produced an additional driving force that enhanced grain growth. Low amounts (3% to 6%) of strain raised the growth temperature in the case of cold-worked specimens. The presence of precipitates (iron oxides) had little effect on grain growth up to about 800° C. Above that temperature, the grain size increased suddenly. I.v.L.

N64-28872 Naval Research Lab., Washington, D. C. Radiation Div.

CALCULATION OF MAGNETIZATION VS TEMPERATURE CURVES FOR FERRIMAGNETIC MATERIALS

E. Prince 21 May 1963 13 p refs
(NRL-5935; AD-407420)

The equations implicit in Néel's molecular-field theory of ferrimagnetism are set out in considerable detail. The general equations that pertain to magnetic structures with crystallographic long-range order are derived, and the specific pair of transcendental equations that must be satisfied in the case of two sets of antiparallel magnetic spins is written down in a form amenable to solution by automatic computer methods. The dominant interaction is expressed in terms of the magnetic transition temperature, while the two smaller interactions are given as fractions of the dominant one. A computation of the shapes of the curves of the magnetization as a function of temperature shows that, while magnetic and neutron diffraction measurements can determine quite precisely the value of a linear function of these fractions, the actual values of the individual fractions are less precisely determined. It follows that any experimental deviation from the calculated curves is due to an inadequacy of the theory rather than to incorrect values of the parameters. Finally, methods of attack for computation of more complex cases are discussed. Author

N64-28884* Space-General Corp., El Monte, Calif.

REPORT ON AN INVESTIGATION OF PROBLEMS IN THE MEASUREMENT OF THIN EVAPORATED METAL FILMS ON MYLAR

E. G. Blackwell Jun. 1964 46 p
(Contract NAS1-1732)
(NASA-CR-58530; SGC-22OS-3) OTS: $4.60 ph

A pneumatically extended paraglider has been fitted with capacitance-type micrometeoroid detectors on the wing membranes, and the data collected by these sensors were analyzed. The performance of such sensors of metalized mylar films is found to depend greatly on the thickness of the metal film, with the optimum thickness being one-tenth the dielectric thickness of the mylar. This project report deals with the application of nondestructive thickness indicators and laboratory instruments as monitors for thin vacuum-deposited metallic films in production and in inspections before assembly. D.E.R.

N64-28886* General Telephone and Electronics Labs., Inc., Bayside, N.Y.

INVESTIGATION OF ELECTRO-OPTIC TECHNIQUES FOR CONTROLLING THE DIRECTION OF A LASER BEAM Final Report

V. J. Fowler 10 Aug. 1964 79 p refs
(Contract NASw-731)
(NASA-CR-58626; TR-64-304.5) OTS: $7.60

An investigation of electrooptic and piezoelectric methods for precision rapid deflection of laser beams is described. The program included the design, development, and evaluation of a number of electrooptic variable refraction deflectors and piezoelectric shear-plate mirror deflectors. These structures all have inherent capabilities for extremely rapid deflection, although high-speed operation was not an objective of this program. It was determined that these structures could be designed to achieve deflection angles of about 1° with minimum beam angles of about 0.01°. Relatively large amounts of stored energy are required to obtain maximum deflection, necessitating the use of narrowband deflection signals for operation at scan frequencies in the range from 10 to 100 kc/s. Precision deflection is feasible but difficult, requiring temperature stabilization and high field correction. Author

N64-28889* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THE MOSSBAUER EFFECT

Marjorie M. Ford 2 Apr. 1964 15 p refs
(NASA-CR-58592; JPL Lit. Search-512) OTS: $1.60 ph

These 96 abstracts deal with the Mössbauer effect in the fields of gravitation, relativity, solid-state physics, lattice mechanics, elementary particle-nuclei, and magnetic properties of solids. A.W.

N64-28903 Naval Ordnance Lab., Corona, Calif. Research Dept.

PROPERTIES OF PHOTODETECTORS Photodetector Series, 61st Report, Sep. 1963–Apr. 1964

A. B. Naugle, J. D. Merriam, and W. L. Eisenman 1 Jun. 1964 27 p ref
(NOLC-602; AD-444180)

This report presents the results of measurements made on 10 photodetectors. It includes data sheets on PbS, InSb, and Ge cells, and a thermocouple. Author

N64-28964* Chicago U., Ill. Labs. for Applied Sciences
ABSOLUTE FLUORESCENT QUANTUM EFFICIENCY OF SODIUM SALICYLATE
Rinda Allison, Jay Burns, and A. J. Tuzzolino Repr. from J. Opt. Soc. Am., v. 54, no. 6, Jun. 1964 p 747–751 refs
(Grant NsG-276-62)

The absolute fluorescent quantum efficiency of sodium salicylate was measured by two different methods and found to be 0.99 ± 0.03 fluorescent quanta emitted per incident ultraviolet quantum at 2,537 A. Measurements were also made at 1,216 and 1,611 A by one of the methods, and the quantum efficiency was found to be 0.94 at both wavelengths. The energy conversion efficiency was found to be 0.57 at 2,537 A, 0.35 at 1,611 A, and 0.26 at 1,216. A. The angular distribution of flourescence and the quantum efficiency were found to depend upon salicylate thickness. The quantum efficiency displays a broad maximum for thicknesses in the range 2 to 4 mg/cm^2, and the angular distribution follows closely a cosine law in this thickness range. Author

N64-28979 Watervliet Arsenal, N.Y. Benet R and E Labs.
DIFFUSION OF CARBON IN ALPHA IRON
C. G. Homan Apr. 1964 30 p refs
(WVT-RR-6402; AD-442185)

The diffusion of carbon in alpha iron using a tracer technique was performed in the temperature range of 616° to 844° C. A plot of the ln D versus 1/T in this temperature range deviates from the usual straight line behavior. An empirical model that includes the possibility of a carbon-vacancy interaction is proposed to explain this deviation. A calculation based on this model yields qualitative agreement with recent anomalous high-pressure anelastic measurements of carbon in α iron. Author

N64-28999* Rice U., Houston, Tex.
MICROSTRAIN AND LOW FREQUENCY HYSTERETIC DISLOCATION DAMPING IN COPPER SINGLE CRYSTALS
D. M. Barnett and J. M. Robert [1964] 37 p refs
(Grant NsG-6-59)
(NASA-CR-58586) OTS: $3.60 ph

Current knowledge concerning the early stages of yielding in copper is briefly reviewed. A detailed study of the anelastic limit and low-frequency hysteretic damping loss of copper crystals of two levels of impurity (99.999% pure and a Cu-0.01% Al alloy) has been carried out at various prestrains up to a maximum of about 10^{-2}. The anelastic limit and the decrement were found to be independent of temperature in the range 135° to 300° K for the pure crystals. The amplitude dependence of the decrement became less nonlinear with increasing prestrain. The decrement at constant stress amplitude passes through a maximum with prestrain for the Al alloy crystal, but is simply observed to decrease with prestrain for the purer crystals. The decrease in the decrement appears to be related to the onset of stage II hardening in copper. Author

N64-29008* Rice U., Houston, Tex.
ABSORPTION OF ULTRASONIC WAVES IN LiF CRYSTALS
J. P. N. Goodell, J. M. Roberts, F. R. Brotzen, and P. L. Donoho [1964] 7 p refs
(Grant NsG-6-59)
(NASA-CR-58584) OTS: $1.10 ph

Absorption of longitudinal waves (800 to 1,800 mc) in the [111] direction of lithium fluoride crystals was investigated. This high-frequency range was explored for an indication of a dislocation resonant peak. The results indicate the following: (1) The decrement in a [111] oriented LiF crystal has values in the low kmc region equivalent to those predicted by extrapolation from the 15- to 200-mc range. (2) There may be a frequency-dependent absorption at 4.2° K. (3) Handling and heat treatment alter the base level of the decrement, suggesting dislocation damping at these high frequencies. M.P.G.

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-27877* Martin Co., Denver, Colo.
SOLID PROPELLANT ROCKET EXHAUSTS EFFECTS STUDY Phase 1 Report
M. Galmish, T. Ballinger, R. Greene, and G. Batiuk Jul. 1963 106 p refs
(Contract NAS10-389)
(NASA-CR-58074; NASA-CR-63-27) OTS: $9.10 ph

This report presents the results of the Phase I SPREE (Solid Propellant Rocket Exhaust Effects). The effects of solid rocket-propellant exhaust jets impinging on launch-equipment surfaces are presented. Theoretical studies were performed to define engine characteristics, exhaust jet properties, and alumina; particle characteristics in exhaust jets, scaling considerations, materials to insulate and to protect launch equipment, and new facility concepts. A two-phase test program was also developed to verify the theoretical predictions and compile design data beyond the scope of theoretical prediction. R.T.K.

N64-28064 Imperial Metal Industries, Ltd., Kidderminster (Gt. Brit.) Summerfield Research Station
FAILURE CRITERIA FOR CAST-DOUBLE-BASE PROPELLANTS
H. Leeming and A. Parker Jul. 1964 43 p refs
(TR-64/17)

This paper considers simple failure theories for cast double-base propellants, based on a maximum stress criterion of failure at low temperatures and high strain rates, and a maximum strain criterion of failure at high temperatures and low strain rates. The form of the reduced failing stress-time locus is deduced from a knowledge of the reduced relaxation modulus curve, together with a simple empirical equation for nonlinearity. For complex tensile tests in which several strain rates are used, these simple failure theories do not suffice, and a cumulative damage theory based on energy considerations is necessary to obtain good agreement with experimental data. The predictions of these various failure theories are compared with experimental data from simple tension, bi-axial tension, and small-scale rocket motor tests. Author

N64-28096 Tokyo U. (Japan) Aeronautical Research Inst.
STUDIES OF HIGH FREQUENCY COMBUSTION OSCILLATIONS IN A GASEOUS PROPELLANT ROCKET MOTOR
Hiroshi Tsuji and Tadao Takeno Mar. 1964 32 p refs *In* Rept. 391 (vol. 29, no. 13)

The experimental studies were conducted in a research rocket motor burning premixed gases as propellants for investigating the effects of several variables upon the high-frequency combustion oscillations in a rocket motor in detail and making clear the driving mechanism of these oscillations. The effects of the combustion chamber length, the propellant equivalence ratio, the mean chamber pressure, and the shape of the nozzle upon the longitudinal-mode pressure oscillations were examined. The research rocket motor had a rectangular combustion chamber of 5 cm × 8 cm cross section, and the propellants used were the premixed city gas and air. Three modes of the longitudinal pressure oscillations, namely, the fundamental-, the second harmonic- and the third harmonic-mode oscillations were observed in the combustion chamber, and the measured periods of each mode oscillation satisfied the relation of acoustic-mode oscillations. Therefore the high-frequency combustion pressure oscillations may be treated essentially as the standing waves of the longitudinal mode, though the propagating shock-type pressure waves appeared as the feed energy to the oscillation was increased. Author

N64-28170 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ATOMIZATION OF A LIQUID IN A SUPERSONIC FLOW
M. S. Volynskiy 6 Dec. 1963 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), No. 2, 1963 p 20–27
(FTD-NT-63-186; AD-602597)

The development of the combustion process in a high-temperature supersonic flow is determined by the quality of the fuel atomization in the engine atomization, evaporation, and mixing. The results of a study of the form of the torch of atomization and also of the scale of the atomization in a supersonic flow are presented. An examination of the process of atomization is conducted within the framework of an aerodynamically posed problem without computation of the heat transfer and phase transitions (evaporation, dissociation, etc). It is assumed that disintegration of the liquid occurs very rapidly, and that the heat phenomena, in a number of cases, do not succeed in influencing substantially the initial diameter of the particles, but later, of course, are subject to evaporation. I.v.L.

N64-28180 Air Force Systems Command, Wright-Patterson AFB, Ohio Nonmetallic Materials Lab.
FLUIDS FOR HIGH-TEMPERATURE APPLICATIONS
Marc P. Dunnam *In* AGARD Combust. and Propulsion 1963 p 87–110 refs (See N64-28176 20-11) Pergamon: £7

A review is given of the source and nature of high-temperature fuels, lubricants, hydraulic fluids, and electronic coolants problems, and the limitations of the more conventional fluids are discussed. Recent information on the types of advanced high-temperature fuels, lubricants, hydraulic fluids, and electronic coolants and data on their properties are included.
Author

N64-28182 Rocket Propulsion Establishment, Westcott (Gt. Brit.)
STUDIES OF ATOMIZATION AND INJECTION PROCESSES IN THE LIQUID PROPELLANT ROCKET ENGINE
J.D. Lewis *In* AGARD Combust. and Propulsion 1963 p 141–174 refs (See N64-28176 20-11) Pergamon: £7

The extent to which the injection and atomization processes can affect the performance of a liquid-propellant rocket engine is reviewed. Some of the available information on the atomization mechanism and drop-size characteristics of typical rocket engine injectors is presented, and practical studies of injector behavior under combustion conditions are discussed. I.v.L.

N64-28192 Imperial Chemical Industries, Ltd., Kidderminster (Gt. Brit.) Summerfield Research Station
EXPERIMENTAL STUDIES OF UNSTABLE COMBUSTION IN SOLID PROPELLANT ROCKET ENGINES
G. F. P. Trubridge and H. Badham *In* AGARD Combust. and Propulsion 1963 p 497–530 refs (See N64-28176 20-11) Pergamon: £7

This report deals with the methods used to suppress unstable combustion occurring with cast double-base propellants. The three basic methods tried are the use of resonance rods in the charge conduit, additives in the propellant, and noncombustible inserts in the charge. It is concluded that resonance rods and the use of aluminum in the propellant are the best methods of suppressing the instability. Consideration is also given to the effects of engine and charge characteristics on instability and the effect of unstable combustion on engine performance. Author

N64-28193 Stanford U., Calif. Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE EFFECTS OF PARTICLE SIZE AND NON-STOICHIOMETRIC COMPOSITION ON THE BURNING RATES OF COMPOSITE SOLID PROPELLANTS
W. Nachbar and G. B. Cline, Jr. (Lockheed Missiles and Space Co.) *In* AGARD Combust. and Propulsion 1963 p 551–568 refs (See N64-28176 20-11) Pergamon: £7
(Contract AF 49(638)-412)

Analysis of the steady burning of a composite solid propellant of sandwich construction, which was proposed previously as a mathematical model with which to investigate steady burning, is generalized to include nonstoichiometric proportions of fuel and oxidizer. The theoretical dependence of burning rate upon "particle size" and upon stoichiometry is obtained and is illustrated by calculations with data for two composite solid propellants. A rough qualitative comparison is made of the theoretical predictions with some published experimental data. Author

N64-28194 Rocketdyne, Canoga Park, Calif.
STABLE COMBUSTION PROCESSES IN LIQUID PROPELLANT ROCKET ENGINES
S. Lambiris, L. P. Combs, and R. S. Levine *In* AGARD Combust. and Propulsion 1963 p 569–636 refs (See N64-28176 20-11) Pergamon: £7
(Contracts AF 04(647)-672; AF 49(638)-817)

Information is presented on the combustion processes necessary for successful analytical modeling of liquid-propellant rocket engine combustion during stable operation. The theoretical and experimental results of single-propellant droplet combustion and their application in spray-combustion analyses are reviewed. Propellant-spray formation and droplet-size distributions from particular rocket injector types are considered. Recent experimental data, found sufficient for approximate model verification, are shown to be useful for guiding the development of an analytical bipropellant combustion model without the necessity of making simplifying and restrictive assumptions. A description of a new combustion model is given, which is based on detailed spatial accounting of the combustion field for each particular injector-chamber configuration and propellant combination. Author

N64-28195 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
COMBUSTION INSTABILITIES IN BIPROPELLANT FUELED ROCKETS [LES INSTABILITES DE COMBUSTION DANS LES FUSEES A PROPERGOL LIQUIDE]
Marcel Barrere and Jean Corbeau (Lab. de Rech., Vernon) *In* AGARD Combust. and Propulsion 1963 p 637-692 refs In FRENCH (See N64-28176 20-11) Pergamon: L 7

Acoustic instability encountered in rocket engine combustion chambers, fueled with liquid bipropellants, is reviewed, and the experimental techniques for studying this instability are described. The measurement of the pressure and the velocity in the combustion chamber are practically the only two determinations that help in the analysis of the regions of instability. Techniques employed for making these measurements are described. Instabilities at low frequencies are discussed. The distribution of the rate of energy conversion along the chamber is investigated, and the importance of the total energy liberated, during combustion, in interpreting the results of experiments on instability is outlined. Instabilities at high frequencies correspond to an acoustic mode that is associated with the geometry of the rocket chamber. These acoustic instabilities are examined from the point of view of fundamental research and from the point of view of practical research. In both cases, the longitudinal mode and the transverse modes were analyzed. I.v.L.

N64-28236 Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
STUDY OF ARC IGNITION TECHNIQUES FOR SOLID ROCKET PROPELLANTS Technical Documentary Report, 1 Apr.-31 Jul. 1964
V. T. Dinsdale Edwards AFB, Calif., Rocket Propulsion Lab., Aug. 1964 51 p
(Contract AF 04(611)-9706)
(RPL-TDR-64-116; AD-444623)

The feasibility of igniting solid-propellant rocket motors using carbon-to-carbon arc probe, gas generator-arc probe, and comb-shaped arc igniters was proven in laboratory and subscale motor tests. Ten 5-in. CP motors were ignited using variations of the three igniter types. Stop-start capability was partially demonstrated with the quenching and reignition of two motors using the comb-shaped igniter. Tests conducted to verify information retrieved in a literature survey proved the superiority of carbon electrodes for propellant ignition. Other tests showed that either RTV 732 silicone adhesive or polyvinylchloride shrinkable tubing provides satisfactory insulation for the electrodes. Author

N64-28582 Columbia U., New York, N.Y.
RHEOLOGICAL BEHAVIOR OF A FILLED ELASTOMER
E. M. Lenoe, R. A. Heller, A. M. Freudenthal Jun. 1964 124 p refs
(Contract NONr-266(78))
(TR-23; AD-604019)

Rheological behavior of a filled elastomer consisting of a polyurethane rubber and granular potassium chloride was investigated with both long- and short-time loading producing conditions of torsion, uniaxial tension, and compression. The volumetric response of the elastomer was also studied. To represent the observed behavior for moderate stresses and strains, a linear viscoelastic model is developed. Author

N64-28584 Advisory Group for Aeronautical Research and Development, Paris (France)
EXPERIMENTAL METHODS IN COMBUSTION RESEARCH Second Supplement to the Manual
Oxford, N.Y., Pergamon, 1964 293 p refs In FRENCH and ENGLISH

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8. MEASUREMENT OF COMBUSTION DELAY L. Nadaud and M. Pugibet (ONERA) 24 p refs (See N64-28592 20-26)

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10. COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS L. Crocco and D. T. Harrje (Princeton U.) 23 p refs (See N64-28594 20-26)

11. EXPERIMENTAL MEASUREMENTS IN SOLID PROPELLANT ROCKET COMBUSTION INSTABILITY E. W. Price (Naval Ord. Test Sta.) 22 p refs (See N64-28595 20-26)

12. EXPERIMENTATION IN SIMULATED ALTITUDE GAS EJECTION P. Lachaume (Comm. a l'Energie Atomique) 29 p refs (See N64-28596 20-27)

N64-28585 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
EXPERIMENTAL TECHNIQUES FOR PRESSURE MEASUREMENT [TECHNIQUES EXPERIMENTALES POUR LA MESURE DE LA PRESSION]
André Mestre *In* AGARD Exptl. Methods in Combust. Res. 1964 22 p refs In FRENCH (See N64-28584 20-26)

Pressure measurements constitute the basic experimental starting point for the analysis of a combustion chamber. The techniques of pressure measurement described in this report provide an outline of the variety of instrumentation used in conjunction with each of the specific requirements: pressure gages providing direct readings (liquid or membrane) for slowly variable pressures, variable potentiometer gages for frequencies below 100 Hz, strain gages for frequencies between 100 Hz and 1000 Hz, and variable-capacity gages for higher frequencies. I.v.L.

N64-28586 National Gas Turbine Establishment, Pyestock (Gt. Brit.)
STUDY OF FUEL INJECTION IN AIR BREATHING COMBUSTION CHAMBERS
H. Clare, J. A. Gardiner, and M. C. Neale *In* AGARD Exptl. Methods in Combust. Res. 1964 20 p refs (See N64-28584 20-26)

The most common method of injecting fuel into a gas turbine combustion chamber is by means of a swirl atomizer. This device performs the three duties of metering, distributing, and atomizing the fuel. In testing swirl atomizers, metering is tested by measuring the flow factor (flow/$\sqrt{}$ pressure), and distribution is tested by measuring both the spray sheath cone angle and the patterning. The quality of atomization may be tested by the following three methods: (1) the direct method, in which the actual liquid is sprayed and sampled; (2) the simulation method, in which hot wax is sprayed and sampled; and (3) the photographic method, in which the actual liquid is sprayed and photographed. All three methods ultimately produce the number of droplets in each of a selected number of size ranges, and from these data the surface mean diameter of the spray is calculated. Actually, the spray quality depends on how the metering and distribution requirements have been met. Large wetted areas in the swirl chamber, narrow cone angles, and low fuel pressures produce a low spray quality. I.v.L.

N64-28587 France. Ministere des Armees, Paris
STUDY OF INJECTION IN ROCKET MOTOR CHAMBERS WITH HYPERGOLIC FUEL [ETUDE DE L'INJECTION DANS LES FOYERS DE MOTEURS-FUSEES A PROPERGOL LIQUIDE]
Jean Corbeau *In* AGARD Exptl. Methods in Combust. Res. 1964 19 p refs In FRENCH (See N64-28584 20-26)

A review is presented of experimental efforts to resolve problems associated with the injection of hypergolic fuels into rocket combustion chambers. The analytical method of studying the injector is employed, since it alone permits a detailed understanding of injection and combustion. The analysis is applied to flow in the injectors, flow at the injector exit and atomization, and the distribution of the combustible and of the oxidizer. I.v.L.

N64-28588 General Motors Corp., Indianapolis, Ind. Allison Div.
COMBUSTION IN THE HYBRID ROCKET MOTOR
M.C. Hardin *In* AGARD Exptl. Methods in Combust. Res. 1964 8 p refs (See N64-28584 20-26)

Combustion in hybrid rocket motors is reviewed. Various types of motors are described and the effect of the injector on motor performance is discussed. Ninety-percent hydrogen peroxide–solid fuel (polyethylene) injector units were investigated, as were the following types of liquid injectors: (1) hollow-cone single-point atomizing units; (2) shower-head and shower-head impinging jet atomizers; (3) probe or "picolo" units; and (4) splash plate or vaporizing chamber injectors. Three principal types of internal burning charge configurations were examined in the hydrogen peroxide–polyethylene motor tests. They were rod and tube, straight tube charge, and a turbulator ring configuration. Hybrid units tested have ranged from microrockets of 25-lb thrust to units of greater then 1,000-lb thrust. In the study of the hydrogen peroxide–polyethylene system, the following were determined: (1) the delivered characteristic velocity; (2) the bipropellant reaction efficiency; and (3) the average burning rate. I.v.L.

N64-28592 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
MEASUREMENT OF COMBUSTION DELAY [MESURE DES DELAIS D'ALLUMAGE]
L. Nadaud and M. Dugibet *In* AGARD Exptl. Methods in Combust. Res. 1964 24 p refs In FRENCH (See N64-28584 20-26)

Methods for determining ignition delay and their applications are reviewed. It is indicated that laboratory methods employed for the measurement of initial ignition delay permit a systematic study of the various parameters effecting this delay, as well as the classification and selection of hypergols in such a manner that delay can be ameliorated by the action of additives. Methods of measuring initial ignition delay with the help of a microrocket permit an approximation of the operating conditions of rocket engines and a study of the effect of such parameters as the type of injection and the injection pressure. It is possible that the microrocket could be used to measure initial ignition delay during flight. Another method of delay measurement during flight is proposed. It consists of instrumentation for detecting the first elevation of pressure in the piping of one of the components of the bipropellant, detecting the first elevation of chamber pressure, and of instrumentation for measuring flow time. I.v.L.

N64-28593 Commissariat a l'Energie Atomique, Saclay (France)
LIMITS OF STABILITY IN REACTOR CHAMBERS [LIMITES DE STABILITE DANS LES FOYERS DE REACTEURS]
R. Dubarry-Barbe *In* AGARD Exptl. Methods in Combust. Res. 1964 25 p refs In FRENCH (See N64-28584 20-26)

Methods for determining the limits of engine combustion stability are reviewed. Discussed are (1) the definition of limits of stability—operating range; (2) stabilization of the flame—as influenced by aerodynamic and thermodynamic factors, flow velocity at the entrance of the chamber, temperature, pressure, the effect of chamber dimensions, the characteristics of the carburetant, and the injection of the carburetant; (3) a bench study of a model prototype combustion chamber—aerodynamic and combustion chamber studies; (4) an investigation of the stability limits of a combustion chamber at the bench—a description of the bench, feeding conditions (simulated flight tests), the determination of the limits of stability in the operating range by varying the flow of the carburetant while maintaining constant pressure, velocity, and temperature at the entrance of the chamber, and the determination of the limits of stability when the velocity or pressure is critical; (5) the connection between combustion chamber instability and oscillations; and (6) the measurement and recording of the principal parameters of stability limits—air flow, carburetant flow, and the temperature, pressure, and velocity at the entrance of the combustion chamber. I.v.L.

N64-28594* Princeton U., N.J.
COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS
Luigi Crocco and David T. Harrje *In* AGARD Exptl. Methods in Combust. Res. 1964 23 p refs (See N64-28584 20-26) (Grant NsG-99-60)

Three types of combustion instability are described—LF instability, IF instability, and HF instability. The latter, which is referred to as acoustic instabilty, is by far the most important for the development of large rocket thrust chambers. The instrumentation on which the detecting of HF instability is based depends on the mode or modes to be detected. Pressure transducers represent a very sound means for the quantitative observation of HF instability. However, accelerometers, placed on the walls of rocket chambers, are often used when it is difficult or impossible to install pressure transducers. Optical means of observation also provide a very effective tool in the study of HF instability. Probably the most effective method to study unstable operations is by determining stability limits.

Each mode may have its own stability limits. With this in mind, methods for determining the following are discussed: longitudinal spontaneous stability limits, transverse spontaneous stability limits, and transverse pulsed instability limits. I.v.L.

N64-28595 Naval Ordnance Test Station, China Lake, Calif.
EXPERIMENTAL MEASUREMENTS IN SOLID PROPELLANT ROCKET COMBUSTION INSTABILITY
E. W. Price *In* AGARD Exptl. Methods in Combust. Res. 1964 22 p refs (See N64-28584 20-26)

Two systems for studying instability are described—full-scale testing and research combustors. The occurrence of combustion instability is usually detected by the occurrence, at low frequency, of erratic pressure fluctuations, associated with the fluctuations in propellant burning rate during oscillatory combustion. Thus, pressure measurements, made by transducers, are important. Another symptom of combustion instability is the presence of vibrations in the structure of the rocket vehicle. These vibrations are measured by accelerometers. High-frequency response instrumentation is often added only after such difficulties have been encountered in the development program. The high-frequency and wideband requirements for recording HF pressure oscillations concurrently with slow variations in mean pressure can be met by the galvanometer oscillograph, the magnetic tape recorder, the cathode-ray oscillograph, and the oscilloscope with attached camera and triggered sweep. Techniques for analyzing data recorded by these instruments consist of frequency–time–amplitude analyses. I.v.L.

N64-28608 Bureau of Mines, Pittsburgh, Pa.
REVIEW OF FIRE AND EXPLOSION HAZARDS OF FLIGHT VEHICLE COMBUSTIBLES
Henry E. Perlee, Elton L. Litchfield, and Michael G. Zabetakis Jun. 1964 22 p refs
(Contract DO 33(616)-60-8)
(ASD-TR-61-278, Suppl. 3; AD-602481)

This report presents experimental results pertinent to inhibition of gaseous detonation, ignition of solid oxygen–liquid hydrogen mixtures, and flammability characteristics of halogenated hydrocarbons. The halogenated hydrocarbons are not particularly effective inhibitors of gaseous hydrogen–oxygen detonation. Combustibles such as methane and hydrogen were superior to the halogenated hydrocarbons on a weight basis. Cryogenic mixtures of solid oxygen and liquid hydrogen can be ignited by 0.5-ounce projectiles moving at speeds as low as 1,310 fps. Ignition appears to occur at shock strengths of 1.5 to 3.0 kilobars. Although the halogenated hydrocarbons considered here do not appear to be flammable in air at atmospheric pressure and ordinary temperatures, some are flammable in oxygen under these conditions. Author

N64-28646 Stanford Research Inst., Menlo Park, Calif.
THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS. PHASE II: A STUDY OF COMBUSTION INSTABILITY AND ITS DEPENDANCE ON PROPELLANT COMBUSTION CHARACTERISTICS Final Report
L. A. Dickinson and E. L. Cadener 14 May 1964 27 p refs
(Contract AF 49(638)-565; ARPA Order-317-62, Amend.3)
(AD-442392)

A range of propellants including several advanced aerospace propellants were studied to learn how the unstable burning characteristics were affected by the following: (1) burning-rate catalysts; (2) oxidizer type; and (3) particle-size variation in the oxidizers and metallic fuels. The studies were conducted in a 5-in.-diameter by 40-inch-long motor that was pulsed, using a well-proven triggering technique. It was found that as the nominal burning rates of the propellants increased, the burning propellants became less responsive to pulsing. In addition, it was noted that the peak-to-peak pressure amplitude of the oscillation steadily decreased as the burning rate increased. The exact role that the burning-rate catalysts performs in the combustion zone is not clear; copper chromite and iron oxide contain cations that complex with ammonia, and they have been shown to be effective catalysts for the decomposition of pure ammonium perchlorate. The incorporation of a coarse oxidizer and coarse spherical aluminum powder lowered the pressure level at which instability could be triggered. Potassium perchlorate produced a fast-burning propellant that would not respond to axial-flow disturbances. I.v.L.

N64-28690 Phillips Petroleum Co., Bartlesville, Okla. Research and Development Dept.
MICRO BURNER STUDIES OF FLAME RADIATION AS RELATED TO HYDROCARBON STRUCTURE Progress Report No. 4
R. M. Schirmer and E. W. Aldrich May 1964 72 p refs
(Contract NOw-60-0406-d)
(RDR-3752-64R; AD-602153)

Measurements were made of total radiant energy from flames for a series of pure hydrocarbons, varying widely in molecular structure and boiling point. This study was conducted using a microburner, which simulates conditions for combustion existing in an aircraft gas-turbine engine. Operation was over a broad range of fuel–air mixtures at atmospheric pressure, with an inlet air temperature of 500° F and cold-flow reference velocity of 26 ft/sec. The effect of hydrocarbon type on flame radiation in the microburner and of hydrocarbon properties on flame radiation in the microburner was determined. An estimate was also made of the degree of correlation between flame radiation in the microburner and aircraft gas-turbine-engine combustors. R.T.K.

N64-28787 Canadian Armament Research and Development Establishment, Valcartier
INVESTIGATIONS ON NONLINEAR AXIAL COMBUSTION INSTABILITY IN SOLID PROPELLANT ROCKET MOTORS
W. G. Brownlee and H. K. Roberts Jun. 1964 22 p refs Presented at the AIHH/CASI/RAeS 9th Anglo-Am. Conf., Cambridge, Mass., 17–18 Oct. 1963
(CARDE-TR-474/64)

Solid rocket motors using CARDEPLEX (polyurethane ammonium-perchlorate) propellants operate in a pseudo-stable regime if the chamber pressure exceeds a certain critical value. In this mode of operation the motors remain stable until a triggering flow disturbance of finite strength occurs within the chamber cavity. A triggering event of sufficient strength initiates the growth of a steep-fronted axial compression wave. The interaction of this oscillating wave with the combustion zone produces an increase in the time-averaged burning rate, pressure, and thrust levels. This phenomenon has been under investigation since 1960. The evidence obtained so far indicates that any single change in formulation that accelerates the stable burning rate tends to increase the critical pressure level. Thus a reduction in binder level, low aluminum loading, the use of very fine aluminum or the incorporation of copper chromite as a rate accelerator lead, in each instance, to an improvement. On the other hand, an increase in the binder level, high aluminum loading, the use of aluminum alloy containing silicon or the addition of lithium fluoride as a rate depressant have an adverse influence. Author

N64-28893* Combustion Inst., Pittsburgh, Pa.
ABSTRACTS OF PAPERS [PRESENTED AT THE] TENTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION, AT THE UNIVERSITY OF CAMBRIDGE, ENGLAND, AUGUST 17-21, 1964
[1964] 211 p refs
(Grants NsG-506; NSF-GN-260; Contract DA-31-124 ARO-D-197 et al)
(NASA-CR-58629) OTS: $14.50 ph

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1. FLAME CHEMISTRY p 1–24 refs
2. DISCUSSION ON ELEMENTARY COMBUSTION REACTIONS p 25–41
3. REACTION KINETICS p 42–63 refs
4. DETONATION p 64–88 refs
5. DISCUSSION ON AERODYNAMICS IN COMBUSTION (FREE BURNING FIRES) p 84–88 refs
6. DISCUSSION ON AERODYNAMICS IN COMBUSTION (ROCKET COMBUSTION INSTABILITY) p 89–92
7. DISCUSSION ON AERODYNAMICS IN COMBUSTION (LOW-SPEED AND HIGH-SPEED COMBUSTION PROCESSES) p 93–98
8. COMBUSTION AND FLOW p 99–127 refs
9. DISCUSSION ON ELECTRICAL PROPERTIES OF FLAMES p 128–136
10. FIRE RESEARCH p 137–144 refs
11. SOLID PROPELLANT COMBUSTION FUNDAMENTALS p 145–155 refs
12. FLAME SPECTROSCOPY p 156–168 refs
13. GENERAL p 169–176 ref

N64-28913 Naval School of Aviation Medicine, Pensacola Fla.
OBSERVATIONS ON THE BURNING OF A CANDLE AT ZERO GRAVITY
Arthur L. Hall 26 Feb. 1964 6 p refs
(Rept.-5; AD-436897)

The proposition has been advanced that normally combustible materials will not burn at zero gravity unless special conditions exist. Certain combustibles burn better in an atmosphere of oxygen at 5 lb/in.^{2} than in an atmosphere of air at sea level pressure. By using a burning candle as the combustible, it was found that the fire did not extinguish itself during 35 zero g parabolas of 25 to 28 seconds each. The fire at 1 g or zero g burned hotter in the oxygen atmosphere than in the corresponding air atmosphere. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-27897* United Aircraft Corp., Windsor Lock, Conn. Hamilton Standard Div.
AN ENGINEERING STUDY AND PRELIMINARY DESIGN OF A ONE MAN PROPULSION DEVICE FOR LUNAR AND FREE-SPACE ENVIRONMENTS Summary Report
21 May 1964 13 p
(Contract NAS9-2065)
(NASA-CR-58169; PDB-6415) OTS: $1.60 ph

The purpose of the initial task was to define the operation and performance criteria for devices that could propel the astronaut either in free space or on the lunar surface. The interrelationships between the personal locomotion system and the other systems (e.g., the extravehicular suit, portable life-support system, vehicle systems, etc.) were then reviewed to establish interface criteria for one-man propulsion devices. Having established the basic criteria for propulsion devices for the contemplated missions, a study was then made of device concepts applicable to the free space and lunar surface situations that might be encountered. Rough size and weight estimates were made for these concepts. These estimates were then used as input data for design trade-off studies. The results of the design trade-off studies were then used to select the systems concepts that offered the most promise to meet the overall program objectives. These concepts were then used as a basis for the preliminary design efforts. Author

N64-27964 Goodyear Aerospace Corp., Akron, Ohio
STUDY OF THE EFFECTS OF MECHANICAL DAMAGE ON THE PERFORMANCE OF FILAMENT-WOUND MOTOR CASES Final Report, 1 Apr. 1963–1 May 1964
R. A. Burkley, T. J. Boller, and I. R. Butcher 20 Jun. 1964 90 p refs
(Contract NOw-63-0449-c(FBM))
(GER-11623; AD-602632)

The objectives of the study program under this contract were to study the effects of surface flaws on the performance of Polaris filament-wound motor cases, to compare the effect of winding sequence on the ability to resist failure from surface flaws, and to determine the feasibility of various repair techniques. These objectives were accomplished on this program through the fabrication, machine flawing, and hydrotesting of 6- and 18-in.-diameter filament-wound bottles. The bottles were fabricated with WS-1028A preimpregnated glass roving, and the wall thicknesses were similar to the full-scale Polaris A-3 first- and second-stage motor cases. Author

N64-27967* National Aeronautics and Space Administration, Washington, D.C.
NUCLEAR SPACE PROPULSION SYSTEMS
Harold B. Finger [1964] 33 p Presented at the Intern. Council of the Aeron. Sci., 4th Congr., Paris, 24–28 Aug. 1964
(AIAA Paper-64-556) AIAA: 3 Fr.

Space propulsion systems that use nuclear-energy sources are described. Work on nuclear rockets, electric propulsion systems using the nuclear-reactor energy source, electric thrustor technology, and nuclear-reactor electric power are discussed. R.T.K.

N64-27988 Joint Publications Research Service, Washington, D.C.
MECHANICS OF COSMIC FLIGHT WITH SMALL THRUST. III
G. L. Grodzovskiy, Yu. N. Ivanov, and V. V. Tokarev *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 126–176 refs (See N64-27976 20-23) OTS: $5.00

This report deals with the problem of optimization in the mechanics of cosmic flight with engines of limited power (limited controlled propulsion system). Discussed are the assigned time of operation of the engine, gradual optimization of optimal controls, a collection of engines of limited power and limited exhaust velocity, problems of optimization taking

into account the operational reliability of the propulsion system, a correction of trajectory, the auxiliary weight components of a propulsion system of limited power, and those propulsion systems related to propulsion systems of limited power. I.v.L.

N64-28052* Electro-Optical Systems, Inc., Pasadena, Calif.
ION ROCKET ENGINE SYSTEM RESEARCH AND DEVELOPMENT Final Report, 27 Dec. 1962–29 Feb. 1964
R. C. Spieser, R. M. Worlock, F. A. Barcatta, G. C. Reid, and G. Sohl 28 Jun. 1964 226 p refs
(Contract NAS3-2516)
(NASA-CR-54067; EOS-3670-Final) OTS: $15.00 ph

An applied research and development program on an electron bombardment cesium ion engine system is reported. The engine system includes a zero-gravity feed system and an automatic control system. The 3-kw engine system produces a thrust of 0.04 to 0.05 newtons at a specific impulse between 4,000 and 7,000 seconds. Component development, system integration, and system tests are described in detail. Author

N64-28081* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF THRUSTOR ARCING ON ION ROCKET SYSTEM DESIGN
John B. Stover Washington, NASA, 1964 20 p refs Presented at the AIAA Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(NASA TM-X-52045) OTS: $1.60

The effect of generator, transformer, and inserted impedances on system stability and efficiency, and on the operating lifetime of thrustor components is considered. Rate of arcing, preferential arc paths, speed of arc interruption, and response of thrustors to voltage transients are also discussed. The study indicates that arcing is a system hazard and that arcing rates are of prime importance in the design and development of thrustors, thrustor arrays, and system components. Two system models for reducing the hazard are proposed, based on principles developed herein, published data, and experience available from operation of a nine-module electron-bombardment thrustor array. Author

N64-28184 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
PROPULSION NOZZLES FOR LARGE EXPANSION RATIOS [TUYERES PROPULSIVES A GRAND RAPPORT DE DETENTE]
E. Le Grives *In* AGARD Combust. and Propulsion 1963 p 217–246 refs In FRENCH (See N64-28176 20-11) Pergamon: £7

The aerodynamic performance of various types of rocket nozzles is reviewed. Cone, bell, wedge, plug, and expansion-deflection nozzles are described, and their relative efficiencies and optimization are examined in terms of thrust coefficient, weight, length, and surface area. Of particular interest is the conclusion that it is possible to calculate the thrust coefficient satisfactorily, even for large expansion ratios, if a constant ratio of specific heats is assumed. I.v.L.

N64-28191 Rocket Propulsion Establishment, Westcott (Gt. Brit.)
THE NON-DESTRUCTIVE TESTING OF SOLID PROPELLANT ROCKET MOTORS
D. S. Dean *In* AGARD Combust. and Propulsion 1963 p 483–493 refs (See N64-28176 20-11) Pergamon: £7

Examinations that present the greatest difficulty in the nondestructive testing of solid-propellant rocket motors are those of the bond between propellant and case, or liner and case, and particularly between liner and propellant. Ultrasonic methods are the most satisfactory for the first two problems, but radiology must be resorted to for the third problem if the motor case geometry is irregular. Because of fine focus and high penetration, the betatron seems to be the best radiation source, but ultrasonic methods under development may provide an alternative method of carrying out this examination. Voids and cracks in propellants can best be detected using a high-energy radiation source, such as the betatron or radioisotopes. Neutron radiography could eliminate the problem of penetrating the steel casing of the motor, but sources and detectors will need further development. Attention should be given to methods of detecting propellant-aging while in storage. Automation of inspection systems is desirable. I.v.L.

N64-28304* Hughes Research Labs., Malibu, Calif.
A NEW CATHODE MERCURY ELECTRON-BOMBARDMENT THRUSTORS
W. O. Eckhardt, J. A. Snyder, H. J. King, and R. C. Knechtli N.Y., AIAA [1964] 7 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Partially Sponsored by NASA)
(AIAA Paper-64-690) AIAA: $0.50 members, $1.00 non-members

It was demonstrated that open-pool mercury cathodes can be used in electron-bombardment ion sources, yielding simultaneously expellant mass utilizations $\geq$ 80% and power expenditures (excluding magnet power) $<$ 500 ev/ion. More than 10 electrons per atom were furnished under these conditions. The cathodes used for these experiments required no phase separation in the feed system, but they were not gravity independent. It was also demonstrated that gravity-independent liquid-mercury cathodes are feasible, and that they can be operated in electron-bombardment ion sources. Gravity-indenpendent liquid-mercury cathodes were designed that furnished between 10 and 30 electrons per atom, and preliminary thrustor experiments with cathodes of this type yielded expellant mass utilizations $>$ 80%. R.T.K.

N64-28357* AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
DEVELOPMENT OF A 3-KILOWATT RESISTOJET
Stewart Bennett, J. F. Connors, and Kenn E. Clark N.Y., AIAA [1964] 16 p refs Presented at AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Contract NAS3-4101)
(AIAA Paper-64-672) AIAA: $0.50 members, $1.00 non-members

A 3-kw resistojet thrustor was operated for a 293-hr period. The specific impulse level with hydrogen propellant was 840 seconds, and the efficiency 67%. Metallographic analyses of test elements lead to the tentative conclusion that contact between boron nitride insulation and tungsten heater elements should be avoided, as was done in the test thrustor. A nozzle analysis was performed to select the expansion area ratio and conical divergence angle; the effects of boundary-layer build-up on the effective area ratio and of shear forces were included. Author

N64-28358* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL ANALYSIS OF THE EXHAUST BEAM FROM A COLLOID THRUSTOR

Carl T. Norgren and Daniel S. Goldin N.Y., AIAA [1964] refs Presented at AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(AIAA Paper-64-674) AIAA: $0.50 members, $1.00 nonmembers

A homogeneous-condensation type colloid thrustor was operated with mercurous chloride propellant and with accelerating voltages up to 18 kv. The exhaust beam was analyzed with a unique quadrupole mass filter. A single high intensity particle spectrum with a mass distribution of 0.72×10^7 to 1.38×10^7 atomic mass units per unit electron charge (amu/z) was detected when the propellant flow was in the continuum-flow regime. It was estimated that a loss in overall thrustor efficiency of less than 2% would be incurred due to this narrow particle spectrum. A low intensity of charged particles over the range of about 10 to 1×10^6 amu/z was detected when the flow was in the slip-flow regime. No colloids were detected when propellant flow was in the free-molecular regime. A theoretical study based on the liquid-drop theory of nucleation was used to correlate the colloid formation behavior. The data taken in this program are also compared with previous data. Homogeneous condensation could provide the narrow amu/z distribution required for a high-performance electrostatic rocket. Author

N64-28359* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF THRUSTOR CHARACTERISTICS ON ELECTRIC SPACECRAFT MISSIONS
William R. Mickelsen N.Y., AIAA [1964] 12 p refs Presented at AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(AIAA Paper-64-676) AIAA: $0.50 members, $1.00 nonmembers

Electric spacecraft mission performance depends critically on the mass of the electric propulsion system. The electric powerplant is often assumed to be by far the heaviest component of such systems. It is shown, however, that when power conversion, power conditioning, and thrustors are included in mission analysis, the total effective specific mass of the electric propulsion system may be much higher than that of the electric powerplant alone, resulting in significant loss of payload or increase in trip time. A method of system analysis is presented that determines the effect of each subsystem on the propulsion system effective mass. With the aid of this method, effective specific masses are estimated for a range of powerplant specific masses and for a number of missions. Results indicate that existing electric thrustors are primarily responsible for these large effective specific masses because of inability to operate with a variable specific impulse, requirements for power conditioning, thrustor mass, and thrustor inefficiency. Author

N64-28360* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
APPLICATION OF MAGNETIC-EXPANSION PLASMA THRUSTORS TO SATELLITE STATION KEEPING AND ATTITUDE CONTROL MISSIONS
George R. Seikel, David N. Bowditch, and Stanley Domitz N.Y., AIAA [1964] 15 p refs Presented at AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(AIAA Paper-64-677) AIAA: $0.50 members, $1.00 nonmembers

Magnetic-expansion plasma thrustors are devices in which the nondirected electron energy resulting from low-pressure d.c., radiofrequency, or microwave discharges is converted into directed ion energy through expansion in a magnetic nozzle. Data are presented for a coaxial hot-cathode d.c. thrustor using ammonia or argon propellant. The required magnetic fields are modest. The discharge voltages are sufficiently low to permit direct operation from solar cells with potentially long life cathodes. Performance was determined by mounting the thrustor on a pendulum thrust stand inside a vacuum facility. The experiments determined the necessity of operating the thrustor in a pressure environment of 2×10^{-5} torr or less to obtain pressure-independent performance. Measurements of the force on the magnet showed that, with magnetic nozzle field configurations, the thrust is predominantly electromagnetic, so that electromagnetic thrust vectoring may be employed. Author

N64-28361* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
CATHODE DURABILITY IN THE MERCURY ELECTRON-BOMBARDMENT ION THRUSTOR
William R. Kerslake N.Y., AIAA [1964] 15 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(AIAA Paper-64-683) AIAA: $0.50 members, $1.00 nonmembers

A mercury electron-bombardment ion thrustor was used to evaluate the performance and durability of four types of cathodes. They were refractory metal (tantalum and tungsten), oxide impregnated nickel matrix, lanthanum hexaboride surfaces, and units employing a thick oxide layer containing reinforcing wires. The most successful refractory metal was a tantalum ribbon cathode, which had a practical lifetime of 150 hr in a thrustor. Oxide-impregnated nickel-matrix cathodes failed in 189 hr or less because of the environment of the ion discharge chamber. The lanthanum hexaboride surfaces failed after several hours and were abandoned in favor of the more promising thick-oxide-layer cathodes. The thick-oxide-layer cathode demonstrated a lifetime of 1,660 hours in a simulated ion thrustor and 615 hours in a 10-cm-diam thrustor operating at 0.25 amp beam current with a net accelerating voltage of 4,000 v. In all cases the thick-oxide-layer cathode required five times less heating power per emitted ampere than the refractory metal cathodes. Author

N64-28362* Hughes Research Labs., Malibu, Calif.
ELECTRODE MATERIALS FOR CONTACT ION ENGINES
Hugh L. Garvin and R. G. Wilson N.Y., AIAA [1964] 12 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964
(Contracts NAS3-4109; NAS3-5249)
(AIAA Paper-64-684) AIAA: $0.50 members, $1.00 nonmembers

One of the factors that has previously been observed to limit lifetime performance of contact ion engines has been the erosion of the electrode structures. The most noted erosion is of the accelerating electrodes on surfaces facing the focusing electrodes. Examinations of ion and atom trajectories show that neutral cesium atoms that evaporate from the porous tungsten ionizer tend to scatter from the accel electrodes and fall onto the focus electrodes, which, because of their proximity to the ionizer, may be at a temperature sufficiently high to cause ionization. Recent experiments were performed to determine which materials are best suited for use in these electrode structures. The criteria are discussed for selection of electrode materials that permit maximum engine performance and lifetime, and results are presented of the measurement of ion and electron emission characteristics for materials including copper, molybdenum, thoriated tungsten, platinum, tungsten, and molybdenum di-silicide. Author

N64-28363* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

EFFECTS OF PLASMA NON-UNIFORMITY ON GRID EROSION IN AN ELECTRON BOMBARDMENT ION ENGINE

Daniel J. Kerrisk and T. D. Masek N.Y., AIAA [1964] 29 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964

(Contract NAS7-100)

(AIAA Paper-64-688) AIAA: $0.50 members, $1.00 nonmembers

Experiments were conducted to determine if plasma nonuniformities would cause nonuniform sputtering patterns on the bombarded grid, and to determine how seriously this would affect grid performance. The results indicated that maximum sputtering rates in the cases studied were about 50% higher than the average rates. It was concluded that nonunifomity in the sputtering distribution can be expected, but that for the cases studied, the problem can be eliminated by proper design.

P.V.E.

N64-28364* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EXPERIMENTAL PERFORMANCE OF A 50 CENTIMETER DIAMETER ELECTRON-BOMBARDMENT ION ROCKET

Paul D. Reader N.Y., AIAA [1964] 8 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964

(AIAA Paper-64-689) AIAA: $0.50 members, $1.00 nonmembers

Scaling investigations of 5- to 20-cm-diam thrustors were extended to 50-cm-diam thrustors. A variable-flow propellant distributor and multiple cathodes were used to smooth the current density profile at the screen grid. Current density traces are presented. The qualitative performance of the 50-cm unit was similar to the smaller thrustors. Ion-chamber losses were significantly lower than the values extrapolated from small-thrustor data. Thrustor efficiency was 83% at the design conditions of 9,000 sec specific impulse, 0.11-lb thrust, and 21.5 kw of effective jet power. These conditions correspond to a 10,000-hour accelerator-electrode durability. Thick oxide-layer cathodes were substituted for the refractory units normally used and resulted in an increase in thrustor efficiency to 88% at the above design conditions. The 0.11-lb thrust level was continuously maintained for 65 hr using oxide cathodes. Thrustor output could be maintained with two of the four cathodes at the expense of a few percent in thrustor efficiency.

Author

N64-28365* Electro-Optical Systems, Inc., Pasadena, Calif.

HIGH-PERFORMANCE CESIUM IONIZERS MADE FROM SIZED SPHERICAL TUNGSTEN POWDER

M. La Chance, G. Kuskevics, and B. Thompson N.Y., AIAA [1964] 12 p refs Presented at the AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964

(Contract NAS3-2519)

(AIAA Paper-64-692; EOS-3720-Final) AIAA: $0.50 members, $1.00 nonmembers

Sized tungsten microspheres of ~ 3μ, 5μ, and 7μ mean diameter were used to fabricate cesium ionizers having improved uniformity, pore character, and ionization performance. With particle size the only intended variable, a gradient series of 80%-dense porous structures was prepared. Fabrication procedures plus data on sintering rates, densities, permeability coefficients, mean pore sizes, pores/cm^2, spectrographic purity, and cesium ionization performance are presented. Cesium ion current densities to 60 ma/cm^2 were achieved with 3μ and 5μ powder ionizers. Neutral fraction at 50 ma/cm^2 was 1% to 3%, considerable improvement over commercial tungsten and unsized spherical powder ionizers. Critical temperature was below Langmuir data for solid tungsten. Neutral fraction versus ionizer temperature curves for the 3μ experimental ionizers showed definite minima, and approximated slopes predicted by the Saha–Langmuir equation for work function 4.6 to 4.8 ev. Neutral fraction and critical temperature decreased with pore size for these structures. Photomicrographs confirm that use of 3μ particles increased pores per unit ionizing area 5.5X, and reduced mean pore size 0.4X. The fine spherical powder ionizers reached much higher current densities with lower neutral fractions than any other tungsten ionizers tested.

Author

N64-28367* Litton Industries, San Carlos, Calif.

TWO-DIMENSIONAL COMPUTER EXPERIMENTS ON ION-BEAM NEUTRALIZATION

R. P. Wadhwa, D. F. Brauch, and O. Buneman (Stanford U.) N.Y., AIAA [1964] 8 p refs Presented at The AIAA 4th Elec. Propulsion Conf., Philadelphia, 31 Aug.–2 Sep. 1964

(Contract NAS3-2503)

(AIAA Paper-64-698) AIAA: $0.50 members, $1.00 nonmembers

A fast method for analyzing the space-charge neutralization mechanism in a two-dimensional ion engine configuration is presented for studying two-dimensional space-charge problems with arbitrary boundary constraints. It is applied here to the problem of creating a moving plasma. A good plasma is formed, and the ion beam remains well compressed when enough electrons are emitted. Residual ion-beam spread is inversely proportional to ion mass and would be invisible for heavy (cesium or mercury) ions. Cutting off the electron emission leads to ion turn-around and thrust deterioration. Ship potential fluctuations of varying intensity are present in all cases.

Author

N64-28371* General Electric Co., Philadelphia, Pa. Missile and Space Div.

APPLICATION OF NUCLEAR ELECTRIC PROPULSION TO ADVANCED SCIENTIFIC MISSIONS

Thomas F. Widmer and Harold Brown N.Y., AIAA [1964] 28 p refs Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1–4 Sep. 1964

(Contract NAS3-2533)

(AIAA Paper-64-714) AIAA: $0.50 members, $1.00 nonmembers

Advanced scientific missions throughout the solar system were analyzed to determine payload and velocity requirements for nuclear–electric propelled spacecraft. Emphasis is placed upon those missions that are too difficult for all-chemical propulsion, even with boosters as large as Saturn V. In parallel with the mission analysis, spacecraft designs were prepared, and key problems of powerplant integration were investigated. Particular attention is given to the radiator and its effect upon vehicle configuration. The spacecraft integration studies have shown that advanced nuclear powerplants should weigh 25 to 35 lb/kw for systems of about 2,000° F maximum temperature and 250-kw to 3-mw power output. Propulsion times range from about 5,000 hr to more than 30,000 hr, depending upon the mission. Lower specific powerplant weight (less than 30 lb/kw) has only a slight effect in reducing powerplant life requirements. In terms of maximum flexibility and multimission capability, the most attractive system is a 90,000 lb spacecraft with 1 mw of power to the engines. This vehicle is boosted to earth escape velocity by Saturn V. Other favorable combinations of powerplant and spacecraft are obtained with ratings as low as 250 kw, by boosting beyond escape velocity to achieve minimum propulsion time.

Author

N64-28372* RAND Corp., Santa Monica, Calif. Aero-Astronautics Dept.
ELECTRICAL PROPULSION FOR SPACE MISSIONS: PLANNING CONSIDERATIONS
Benjamin Pinkel N.Y., AIAA [1964] 24 p refs Presented at the 3d Biennial Aerospace Power Systems Conf., Philadelphia, 1-4 Sep. 1964
(Contract NAS8-11081)
(AIAA Paper-64-715) AIAA: $0.50 members, $1.00 nonmembers

Electrical propulsion systems are being proposed for advanced space missions because of their extremely high specific impulse relative to more conventional systems now under development. This paper presents information pertinent to research and development planning relative to electrical propulsion systems. Vehicle weights and costs for advanced space missions utilizing electrical propulsion systems and the competitive nuclear rocket and chemical rocket systems are summarized (the Manned Mars expedition, lunar logistic transport, and deep space probe missions are explored). The estimated cost and time to develop the electrical propulsion system are given. The promise of new technologies is discussed. The development cost and time for an electrical propulsion system in the megawatt power class based on current Rankine cycle technology (maximum cycle temperature 2,000° F) are estimated at over $3 billion and 12 years, respectively. The mission studies revealed no economic or performance advantage sufficiently compelling to warrant the early initiation of a full scale development based on the current Rankine cycle technology. Present emphasis should be placed on exploratory engineering studies relating to Rankine, Brayton, and thermionic systems, and research on new technologies. Author

N64-28454 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Strahlantriebe
PROGRESS IN THE DEVELOPMENT OF CONTINUOUS ELECTROMAGNETIC PROPULSION SYSTEMS [FORTSCHRITTE BEI KONTINUIERLICHEN ELEKTROMAGNETISCHEN ANTRIEBSANLAGEN]
Gunther F. Au Repr. from Luftfahrttech. Raumfahrttech. (W. Germany), v. 9, no. 3, 4, 6, 7, 1963 22 p refs in GERMAN
(DFL-232)

Progress concerning continuous electromagnetic propulsion systems for space flight is discussed, with emphasis on the following areas: (1) problems of arc plasma and electrothermal propulsion; (2) investigations of two-component arc plasmas; (3) heat-transfer properties of gases; (4) the stabilization of arc plasmas; (5) continuous plasma acceleration in electromagnetic fields—plasma acceleration in crossed electric and magnetic fields, the three-fluid theory of plasma acceleration in crossed electric and magnetic fields, traveling field acceleration, and loss mechanisms. In addition, the motion of charged particles in crossed electric and magnetic fields is discussed. I.v.L.

N64-28462* General Electric Co., Cincinnati, Ohio Missile and Space Div.
DEVELOPMENT OF A 30-KW THREE-PHASE AC ARC JET PROPULSION SYSTEM Final Report, 18 Jan. 1963–17 Jan. 1964
Robert Richter 4 Aug. 1964 255 p refs
(Contract NAS3-2523)
(NASA-CR-54112) OTS: $16.50 ph

This report presents the results of a research and development program aimed at the development of a 30-kilowatt three-phase a.c. plasma arc jet engine. The primary objective was to design a 30-kw three-phase engine for operation with hydrogen as propellant performing at a minimum specific impulse of 1,000 seconds and a minimum thrust of 0.5 lb for a minimum duration of 250 hr. The operation of a modified three-phase plasma arc jet engine design is discussed. A complete discussion of Engine Y16-1 is given. Engine Y16-2 is also discussed—this engine is similar to Engine Y16-1 except that larger electrodes are used. The long duration engine test is described. A single phase a.c. plasma arc jet engine is described. This engine was designed to operate with a.c. or d.c. under a wide range of conditions. A number of technical efforts carried out in support of the main goals of the program are presented. Author

N64-28596 Commissariat a l'Energie Atomique, Saclay (France)
EXPERIMENTATION IN SIMULATED ALTITUDE GAS EJECTION [EXPERIMENTATION EN ALTITUDE SIMULEE DE L'EJECTION DES GAZ]
P. Lachaume *In* AGARD Exptl. Methods in Combust. Res. 1964 29 p refs In FRENCH (See N64-28584 20-26)

This report describes the setups and experimental methods used in the jet engine test center for determining turbojet and ramjet performance at simulated altitudes and contains indications for applications other than in this specific field, such as studies and testing of complete chambers at atmospheric pressure or at low pressure. Emphasis is placed on: (1) direct and indirect measurements of the mean temperature (T), which permit the determination of combustion performance for the case of propulsion units without reheating, where $T < 1{,}100°$ K and of ramjets and propulsion units with reheating, where $T > 1{,}100°$ K; (2) direct and indirect measurements of the mean pressure, which give the level of pressure loss; (3) the sum of the carburetant flow and the carburetant flow absorbed by the engine; (4) the determination of the effective section of the nozzle; and (5) the determination of total thrust. In addition, visual means of observing flows at nozzle exits, in the case of ramjets and of jets with afterburners, is discussed. I.v.L.

N64-28619 Marquardt Corp., Van Nuys, Calif.
RAMJET TECHNOLOGY PROGRAM, VOLUME II. SECTION XIV: AEROTHERMAL CAPABILITY OF PLASMA HEATERS. SECTION XV: HIGH PRESSURE AIR GENERATION Final Summary Technical Report, Calendar 1963
J. K. Totten Jun. 1964 80 p
(Contract AF 33(657)-12146)
(Rept.-25116; AD-602048)

The objective of the plasma arc heater program was basically to design, fabricate, and test plasma heaters capable of operating at pressure levels beyond the current state-of-the-art. The experimental pressure range was to be between 1,000 psia and 8,000 psia. During this program all of the program goals were exceeded; one particularly outstanding test run with air at 2,800 psia produced a gas enthalpy level of 3,150 Btu/lb at a 0.135 lb/sec flow rate with an arc power of 1.12 mw. The purpose of the high-pressure air-generation program was to demonstrate the practicability of creating extremely high pressures utilizing the principle of heating a cryogenic fluid in a constant volume vessel. The numerical goal of pressure levels in excess of 50,000 psia was sucessfully met when one test run attained a pressure level of 62,800 psia, at a fluid temperature of 790° R. Author

N64-28697 Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center
INCREASED AREA RATIO RL10 ROCKET ENGINE
G. A. Titcomb 26 Mar. 1964 18 p
(PWA-FR-950)

An improved performance RL10 engine model, designed to provide an increased payload capability to the Centaur upper-stage space vehicle, is described. The nominal specific impulse rating of the RL10 engine model described is 444 seconds. An increased expansion ratio is proposed for this Centaur-optimized RL10 engine and is achieved by reducing the throat area. The area ratio is increased by reducing the thrust chamber throat area; therefore, a corresponding increase in chamber pressure is necessary to maintain the same thrust rating. The turbine is modified to meet the increased headrise requirements. This modification provides a substantial improvement in efficiency. Other flow-system revisions of a minor nature, such as increasing pump discharge orifice area and reducing venturi and turbine nozzle areas, further reduce the maximum system pressure associated with the increased chamber-pressure requirement. The installation characteristics of the RL10A-3 and the increased area ratio RL10 are compared. The nature of the proposed engine changes is detailed in tabular form, and a preliminary-design table is presented. R.T.K.

N64-28724* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

EXPERIMENTAL EVALUATION OF SIZE EFFECTS ON STEADY-STATE CONTROL PROPERTIES OF ELECTRON-BOMBARDMENT ION THRUSTOR

Eugene V. Pawlik and Shigeo Nakanishi Washington, NASA, Sep. 1964 27 p refs

(NASA-TN-2470) OTS: $0.75

The steady-state gains (variations of beam current with changes in thrustor input variables) were determined experimentally for a range of electron-bombardment ion thrustor diameters. Thrustor operation was compared for 5-, 10-, and 20-cm-diam exhaust beam sources, primarily at a specific impulse of 4,000 seconds, with mercury as the propellant. The steady-state gains with respect to each thrustor input variable are presented for each thrustor size. The effects of thrustor size on the control properties or gains of the ion thrustor were slight except for the smallest unit. For this case, propellant flow gains were higher than for the other sizes, and a quenching of the plasma was noticeable at low flows. Thrustor operation of a 10-cm-diam unit was also investigated with an alkali earth coated filament. The steady-state gains of this filament were time variant during the initial operating period. Author

N64-28735* Litton Industries, San Carlos, Calif. Research Lab.

ANALYSIS OF ELECTRON-ION MIXING IN ION ENGINES Final Report, Jun. 1962–Feb. 1964

R. P. Wadhwa and G. Kooyers 31 Mar. 1964 213 p refs

(Contract NAS3-2503)

(NASA-CR-54033) OTS: $14.50 ph

Electron-ion mixing is studied in one- and two-dimensional configurations with the use of a high speed digital computer. These studies are important for optimizing the electron emission required for adequate space-charge neutralization of ion beams for ion-engine applications. Ions are injected across the accel grid at constant velocity while electrons are emitted at the decel plane with Maxwellian velocity distribution. Finite dimensions for the ion beam and electron emitter are considered for the two-dimensional configuration. The mathematical formulations in both the cases are normalized in a convenient manner, and the charged particles are updated at every unit-time interval according to self-consistent space-charge and d.c. fields evaluated by superfast methods. Poisson's equation is solved by using Green's method in the one-dimensional configuration and by using the Fourier analysis and marching method in the two-dimensional configuration. For the two-dimensional case, both the ideal (transparent) and actual cases of decel grid are investigated. Several values of ion-electron mass ratio, emission, velocity, and electron emitter temperature are studied. The ship potential and thrust are calculated in each case. Author

N64-28743 Boeing Co., Seattle, Wash. Aero-Space Div.

FUEL CONTAINMENT IN THE GASEOUS-CORE NUCLEAR ROCKET BY MHD-DRIVEN VORTICES

J. B. Romero [1963] 96 p refs Submitted for Publication

(D2-22408)

An MHD-driven vortex is considered for fuel retention in the gaseous-core nuclear propulsion engine. The characteristics of the vortex were obtained from the flow, diffusion, and electromagnetic equations. A simplified method of solution employing arbitrary temperature distributions is used. Rocket engine performance was estimated for two design concepts—a single critical vortex tube and multiple vortex tubes. Both designs are limited by electrical requirements, pressure gradients, and other design considerations. Engine thrust-to-weight ratios in the order of 10^{-2} and 0.4 are obtained for the single-vortex and multiple-vortex concepts, respectively. Performance improvement may be possible by employing bypass flow systems. Author

N64-28815 Ion Physics Corp., Burlington, Mass.

CONDENSATION COLLOIDAL ION SOURCE Summary Technical Report, 1 Jun. 1962–1 Jun. 1963

A. Lucille Cox 12 Jun. 1964 190 p refs

(Contract AF 33(657)-8743)

(ASD-TDR-63-825; AD-602115) OTS: $3.00

This report describes the experimental and analytical efforts on the evaluation of the controlled-growth condensation colloidal-ion-source concept as a means of producing propellant particles for use in an electrostatic ion engine. An improved concept, based on the results of these studies, is presented. It depends on convection rather than radiation for cooling the particles and assumes the presence of electrons in the nozzle. These factors relieve space charge restrictions but necessitate removal of electrons downstream from the throat and increase the requirements for collisions. Design considerations to provide the necessary conditions are discussed and were incorporated in the construction of a controlled-growth colloidal ion engine that performed well in thrust tests. Author

N64-28864* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

POWER CONDITIONING DEVELOPMENT FOR ION ENGINES

James D. Powell, Paul H. Mc Garrell (TRW, Inc.), and William H. Hawersaat [1964] 7 p ref Presented at the 3d Biennial Aerospace Power System Conf., Philadelphia, 1–4 Sep. 1964

(AIAA Paper-64-764) AIAA: $0.50 members, $1.00 nonmembers

In order to produce a system that would power the Lewis ion engine successfully, many things had to be done to the basic power supply. Included were the following: (1) The overload circuit had to be properly timed. (2) The current-limit feature had to be built into both high-voltage supplies. (3) Some series impedance had to be built in the major sources of energy to limit surge currents on transients. (4) All transformers involved in the high-voltage area had to be shielded as did all high-voltage wiring. (5) Zener diodes were required between the

collector and the emitter of all transistors, powering transformers in a high-voltage area. (6) Controlled avalanche diodes were used in all areas where they might be subjected to high-voltage spikes or surges. (7) The power-supply boxes had to be sealed and pressurized to keep the mercury plasma from the engine out of the circuits. I.v.L.

N64-28926* National Aeronautics and Space Administration, Washington, D.C.
A SURVEY OF SPACE NUCLEAR PROPULSION
Harold B. Finger, James Lazar, and James J. Lynch [1964] 117 p Presented at the 1st AIAA Ann. meeting, Wash., D.C. 30 Jun. 1964 Prepared Jointly with AEC
(AIAA Paper-64-523) AIAA: $0.50 members, $1.00 nonmembers

Subjects discussed include the KIWI-B4D nuclear-rocket reactor experiment, electric-thrust engines, nuclear-electric power-generating systems, and advanced nuclear-propulsion concepts. It is concluded that solid-core nuclear rockets are the best understood and most nearly developed of the many advanced nuclear-propulsion concepts being investigated here; that thrustors for electric propulsion are also showing good progress; but that nuclear-reactor electric generating systems are, and will be, a more difficult field in which to show progress. It is also concluded that, beyond these systems, other advanced nuclear-propulsion concepts are not yet well enough understood to justify undertaking large development efforts. D.E.W.

N64-28946* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ELECTRIC PROPULSION FOR SPACECRAFT
Harold R. Kaufman [1964] Repr. from New Scientist (London), v. 23 p 263–265
(NASA-RP-290)

Two systems for creating beams of high-speed ions are discussed. The possibility of their use for driving spacecraft on long missions is considered. Such use, however, must await the development of suitable power units of high-voltage, high-power capacity, and low weight. DE.W.

N64-28953* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NASA ELECTROSTATIC-THRUSTOR RESEARCH AND INSTRUMENTATION
Edward A. Richley [1963] 75 p refs Presented at the Seminar on Exptl. Tech. in High Speed Aerodyn. and Gasdyn., Ohio State U., Columbus, 8–24 Jul. 1963; sponsored by NSE
(NASA-TM-X-51766) OTS: $7.60 ph

Some of the basic principles, theories, and problem areas of electrostatic thrustors are discussed, along with the effects that they have had on the evolution of the thrustor concepts being investigated. Instrumentation and test facilities used in thrustor investigations are also discussed. P.V.E.

N64-28996* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SPACE FLIGHT BEYOND THE MOON. A STORY OF ADVANCED PROPULSION SYSTEMS FOR INTERPLANETARY FLIGHT
William R. Mickelsen Nov. 1962 36 p
(NASA-TM-X-51888) OTS: $3.60 ph

Each advance in propulsion research makes the idea of space exploration beyond the moon more practical. Of the advances discussed, such as the electric rocket thrustor, the ion engine, nuclear rockets, and thermonuclear fusion, the ion engine is the most practical at present. Manned spacecraft for planetary flights and instrumented probes for deep-space exploration require the large and lighter propulsion systems that electric propulsion provides. A.W.

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-28202* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR SIMULATION: THEORETICAL CONSIDERATIONS
In its Goddard Summer Workshop Program in Meas. and Simulation of the Space Environ. [1963] 5 p (See N64-28201 20-23)
OTS: $19.75 ph

The spectral irradiance of the sun in the visible and infrared spectra is approximately that of a blackbody at 6,000° K. This blackbody temperature of solar radiation is so high that no terrestrial source of radiation can be an exact spectral match to solar radiation. Ways in which this satisfactory degree of solar simulation can be achieved are discussed. The best spectral match to solar radiation would be the radiation issuing from an enclosure at about 6,000° K; but such an enclosure presents technical problems because the most refractory material, tungsten, melts at 3,370° C. An alternate method suggested is to make use of the line spectrum of the elements. P.V.E.

N64-28232* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HYDROMAGNETIC STABILITY OF THE MAGNETOSPHERIC BOUNDARY
S. P. Talwar Repr. from J. Geophys. Res., v. 69, no. 13, 1 Jul. 1964 p 2707–2713
(NASA-RP-297)

The problem of the stability of the interface between the solar wind and the magnetosphere is investigated by means of hydromagnetic equations. An explicit criterion of instability is written for the special case in which both the solar plasma and the magnetospheric medium are supposed to be of the same density and carry a uniform magnetic field in the direction of streaming. It is concluded that the magnetospheric boundary is likely to be unstable toward the tail and under comparatively quiet solar conditions. It is suggested that the characteristic effects of instability should be observed toward the night side, preferably with space exploration vehicles.
Author

N64-28387 Joint Publications Research Service, Washington, D.C.
TURBULENCE IN THE INTERSTELLAR MEDIUM
S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 383–384 (See N64-28376 20-29) OTS: $6.00

From observations of the radiation of interstellar gas in rays of hydrogen line Hα, an attempt was made to obtain data on the occurence and nature of turbulence in interstellar gas. G.D.B.

N64-28388 Joint Publications Research Service, Washington, D.C.
THE DENSITY OF MOLECULES IN INTERSTELLAR SPACE
S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 385–386 (See N64-28376 20-29) OTS: $6.00

On comparing the estimates of the intensities of the interstellar lines CH^+ λ4232 and CH λ4300 in the spectra of hot stars, with the reddening of these stars caused by interstellar absorbing dust, it was ascertained for stars of classes O and B0-B1, that the stated values are correlated so that the absorbing molecules are in the same clouds as the dust. G.D.B.

N64-28389 Joint Publications Research Service, Washington, D.C.
THE TEMPERATURE OF INTERSTELLAR MATTER
S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol III 6 Jul. 1964 p 387–388 (See N64-28376 20-29) OTS: $6.00

On the basis of the conditions of equilibrium between the heating and the cooling mechanisms, the problem of interstellar-matter temperature is theoretically solved. G.D.B.

N64-28390 Joint Publications Research Service, Washington, D.C.
ON POLARIZATION OF RADIATION BY INTERSTELLAR MEDIUM
S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 389–390 (See N64-28376 20-29) OTS: $6.00

The study of radiation polarization by the interstellar medium is extended to the infrared region (λ 8,000 A). The possibility is discussed of polarization on scattering of the free electrons, oriented so that their intrinsic magnetic moments are parallel to the interstellar magnetic field. G.D.B.

N64-28721* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECTS OF HIGH ALTITUDE EXPLOSIONS
Wilmot N. Hess Washington, NASA, Sep. 1964 36 p refs (NASA-TN-D-2402) OTS: $1.00

High altitude nuclear explosions have helped considerably in understanding the natural radiation belts. The Argus artificial radiation belt made in 1958 gave information on the stability of particle orbits. The Starfish artificial belt gave quantitative information on electron lifetimes not available any other place. Below L = 1.7 the electrons have a long life and apparently are lost only by coulomb scattering on the atmosphere. Above L = 1.7 the lifetime shortens abruptly and some nonatmospheric process dominates. Synchrotron radiation and aurora were also observed after Starfish. There are some interesting questions left about how the Starfish electrons got where they did and why they have the spectra observed.
Author

N64-28750* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NUCLEAR COMPOSITION AND RIGIDITY SPECTRA OF SOLAR COSMIC RAYS
S. Biswas and C. E. Fichtel Repr. from Astrophys. J., v. 139, no. 3, 1 Apr. 1964 p 941–950 refs
(NASA-RP-248)

Further studies on the composition of solar cosmic rays were made, particularly with regard to the nuclei of charge 10 or more. The results support the earlier conclusion that the composition of the multiply-charged nuclei in solar cosmic rays seems to reflect those of the sun as determined by spectroscopic means for those nuclei where comparisons can be made. The relative abundances of helium and neon that cannot be determined well in the photosphere by spectroscopic means are 107 ±14 and 0.13 ±0.02 relative to oxygen, respectively, for the energetic solar particles. The helium nuclei rigidity spectrum during one period in the November 12, 1960, solar cosmic ray event was extended to lower rigidities than measured previously, thereby permitting a comparison to the proton rigidity spectrum over a wider interval. The result of this analysis, together with previous work, demonstrates that it is unlikely that any of the simple spectral forms proposed in the literature yield a consistent answer for both protons and helium nuclei for all events.
Author

N64-28766* Minnesota U., Minneapolis School of Physics
OBSERVATIONS OF THE SOLAR CORONA FROM THE LIMB OF THE SUN TO THE ZODIACAL LIGHT, JULY 20, 1963
F. C. Gillett, W. A. Stein, and E. P. Ney Repr. from Astrophys. J., v. 140, no. 1, 1 Jul. 1964 p 292–305 refs
(Sponsored by NASA and ONR)

Photographs of the solar corona and zodiacal light from cameras flown on balloons at an altitude of 110,000 ft were obtained on July 20, 1963. The absolute intensity of the light of the solar corona between the limb of the Sun and 70° elongation was determined from these photographs. The absolute brightness polarization, and direction of polarization of the inner corona at effective wavelengths of 4,750 A and 8,300 A were measured from a station at The Forks, Maine. Finally, as a result of photographs taken from the ground, from a jet aircraft at 40,000 ft over Canada, and from balloons at 110,000 feet, it was possible to determine the sky brightness during the eclipse as a function of atmospheric pressure in order to plan for future observations.
Author

N64-28826* National Aeronautics and Space Administration, Washington, D.C.
STUDY OF COSMIC RAY INTENSITY FLUCTUATIONS IN THE STRATOSPHERE, CAUSED BY PROCESSES OCCURRING ON THE SUN [ISSLEDOVANIYE FLUKTUATSIY INTENSIVNOSTI KOSMICHESKIKH LUCHEY V STRATOSFERE, VYZYVAYEMYKH PROTSESSAMI NA SOLNTSE]
A. N. Charakhc'yan Jul. 1964 43 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 83, no. 1, 1964 p 35-62
(NASA-TT-F-9027)

A comprehensive survey of the fluctuations in cosmic-ray intensity in the stratosphere and their relationship to solar activity is presented. Included are the correlation of stratospheric cosmic-ray flares with geophysical phenomena, the energy spectra of the protons generated in flares, magnetic trapping of fast protons, propagation of solar cosmic-ray protons in the interplanetary medium, kinetic energy carried off by a flux of protons, variations in amplitudes of cosmic-ray intensities in flares generated on the visible vs the far side of the solar disk, the phenomenon of 27-day variations in stratospheric cosmic-ray intensity, fluctuations in stratospheric cosmic-ray intensity during magnetic storms and Forbush decreases, and correlation of the rise in primary cosmic-ray intensity with total solar activity based on the number of sunspots.
M.P.G.

N64-28845* Maryland U., College Park
MICROVARIABILITY OF SUN AND STARS Armagh Observatory Leaflet No. 59
E. J. Opik Repr. from Irish Astron. J. (Armagh), v. 6, no. 5, Mar. 1964 p 174–182 refs
(Grant NsG-58-60)

Possible microvariation in the amount of energy radiated by the sun is discussed. Methods of measurement discussed include direct photometry and comparison of reflections from planets with standard stars, and various statistical methods are described. Further work is dependent on continuing observations of the Solar Constant. D.E.W.

N64-28857* Minnesota U., Minneapolis California U., La Jolla
POSITRON-ELECTRON RATIO OF PRECIPITATING ELECTRONS
Laurence E. Peterson (Calif. U., La Jolla) Repr. from J. Geophys. Res., v. 69, no. 15, 1 Aug. 1964 p 3111-3153 refs
(Contract NASw-56, Grant NsG-318)

A balloon observation of the X-ray spectrum from 37 to 700 Kev during the July 1961 solar event series has allowed an upper limit to be placed on the ratio of positrons to electrons during a precipitation as well as on other geophysical processes. The electrons caused the X-ray bursts; no large fluxes above cosmic-ray produced background were observed above about 400 kev. The excess flux at 0.5 Mev, which would be caused by positrons annihilating, was 0.051 ±0.043 photon cm^{-2} sec^{-1} over a 68-minute interval at 2100 UT (1500 local on July 13. A limit of 33 ±26 protons cm^{-2} sec^{-1} in the 1-15 Mev range can be obtained from the 0.5-Mev flux, which would be produced via nuclear reactions. The differential electron spectrum producing the X-rays was fitted to a power law in energy with an exponent of 5.4. The average rate of electron precipitation was 6.4×10^7 electrons cm^{-2} sec^{-1} > 37 Kev, or 2.6×10^{10} cm^{-2} over the 68-minute interval. The limit on the ratio of precipitating positrons to electrons is $(4 \pm 3) \times 10^{-10}$. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-27871* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
INTERPLANETARY MIDCOURSE GUIDANCE ANALYSIS, VOLUME II
Robert Gottlieb Stern (Ph.D. Thesis) [1964] 284 p refs
(Grant NsG-254-62)
(NASA-CR-56895) OTS: $18.00 ph

Included in this volume are coordinate systems; celestial mechanics; graphical constructions; elliptical cylindrical coordinates; variant equations of motion; general matrix formulations; integration of the variant equations of motion for elliptical reference trajectories; determination of variant motion from first variations of orbital elements; variation in position, velocity, and acceleration; low-eccentricity reference trajectories; matrices for elliptical trajectories; fixed-time-of-arrival guidance; optimization of time-of-correction; singularities in the matrix solution for elliptical trajectories; and statistical theory. G.D.B.

N64-27901* Midwest Research Inst., Kansas City, Mo.
ORBITING SATELLITE SURFACE TEMPERATURE PREDICTION AND ANALYSIS Final Report, 4 Feb. 1963–3 Feb. 1964
Harold L. Finch, Duncan Sommerville, Roger Schroeder, and Dean Lawrence [1964] 77 p refs
(Contract NAS9-1059)
(NASA-CR-56277) OTS: $7.60 ph

A computer program to predict the thermal history of spacecraft in orbit was developed. One of the unique features of the program is the ability to compensate for surface temperature gradients of the celestial body being orbited. Spinning, planet-oriented, and sun-oriented vehicles can be evaluated. Numerical techniques for integrating the general thermal differential equation were optimized with respect to accuracy and computation time. The Lunar Excursion Module moon voyage, being planned for the late 1960's, was simulated on the computer. The results confirmed the importance of the program's ability to account for the moon's surface-temperature gradients. Simulated runs gave time-temperature curves that closely approximated the actual curves of the Explorer and Vanguard satellites. R.T.K.

N64-27906* Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.
DOCKING STUDY Final Summary Report, 17 Jun. 1963–12 Jun. 1964
A. J. Besonis, S. I. Lieberman, and W. G. Green 12 Jun. 1964 73 p
(Contract NAS8-5425)
(NASA-CR-58222; BSR-933) OTS: $7.60 ph

The analytical formulation of the optimum (minimum fuel consumption) solution for docking with an earth satellite is described. This formulation is based on the use of calculus of variations and includes the equations for target and chaser motion, the Euler–Lagrange equations, boundary conditions, and corner conditions. All equations are developed in three dimensions. The solution of a two-dimensional set is described, based on the use of an idealized two-impulse transfer to establish a starting point for the iteration process. Author

N64-27943* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
STUDY OF POWERED-DESCENT TRAJECTORIES FOR MANNED LUNAR LANDINGS
Floyd V. Bennet and Thomas G. Price Washington, NASA, Aug. 1964 36 p refs
(NASA-TN-D-2426) OTS: $1.00

The design powered-descent trajectory for the landing mission of the lunar excursion module is divided into three operational phases—an initial fuel-optimum phase, a landing-approach transition phase, and a final translation and touchdown phase. This paper contains an analysis of the operational tradeoffs available in these phases of the descent. Several trajectories were found that yielded satisfactory operational features that allow adequate pilot control of the final approach and at the same time satisfy the abort and fuel economy criteria. Author

N64-27975* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD FOR DETERMINING NODAL ARRIVAL TIMES AT THE MOON FROM PRECESSING NEAR-EARTH PARKING ORBITS HAVING VARIOUS INCLINATIONS

John R. Unangst and Jesse D. Timmons Washington, NASA, Aug. 1964 21 p refs
(NASA-TN-D-2442) OTS: $0.50

Some of the effects of precession of near-earth orbits on the timing of inplane launchings from such orbits for a nodal encounter with the moon are examined. A range of orbit inclinations from 18° to 38° is considered. From comparison with the nonprecessing orbit it is found that the orbit precession produces more frequent possible launch times and, in most cases, shorter intervals between possible launch times.

Author

N64-28058* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
GUIDANCE EQUATIONS FOR QUASI-OPTIMUM SPACE MANEUVERS
D. J. Jezewski Washington, NASA, Aug. 1964 46 p refs
(NASA-TN-D-2361) OTS: $1.25

Approximate time-optimum guidance equations for planetary ascent and descent trajectories at constant thrust are derived for a flat-body two-dimensional case. No aerodynamic forces are considered. In addition, this case was extended by introducing power series to simulate the deleted terms of the round-body solution. A power series in time was chosen to retain the form of the guidance law. Trajectories resulting from this set of equations are compared with the strict optimum for a number of cases to determine the proximity of the solutions. The results match well for both state and control variables in the cases considered. The guidance application was investigated by using the analytic solution to steer an exact integrated model. A comparison of these results with an optimum solution for ascent and descent trajectories shows good agreement. To demonstrate its utility as a trajectory scanner, the technique is applied to the investigation of lunar landing from an elliptic transfer orbit.

Author

N64-28172 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE TRANSITION OF A SPACE VEHICLE, BRAKED IN THE ATMOSPHERE OF A PLANET, INTO THE ORBIT OF AN ARTIFICIAL SATELLITE
V. A. Il'in *In its* Eng. Mag. 13 Feb. 1964 refs p 1–6 (See N64-28171 20-23)

Discussed is the transition of a cosmic vehicle entering the atmosphere with a speed greater than the escape velocity from braking ellipses into the circular orbit of an artificial satellite of the planet. The minimum thrust necessary for the transition is achieved when it is imparted at the moment of contact to the braking ellipse of a given circular orbit in the apogee. A simple formula is obtained for determination of the optimum increase of speed during transition as a function of the height of the circular orbit.

Author

N64-28355* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SATELLITE OBSERVATIONS OF THE GEOMAGNETIC FIELD DURING MAGNETIC STORMS
E. J. Smith, C. P. Sonett, and J. W. Dungey (Space Tech. Labs.) Repr. from J. Geophys. Res. v. 69, no. 13, 1 Jul. 1964 p 2669–2688 refs
(NASA-RP-295)

Explorer 6 satellite data and surface magnetograms are used to study the gradual and sudden commencement geomagnetic storms of August 16–18, 1959. Analysis of these data provides the following conclusions: (1) The geomagnetic field was strongly perturbed but retained its essentially dipolar character out to geocentric distances of 8 earth radii. (2) A long-period variation in the distant field coincided with Dst at the surface. The magnitude of the main-phase decrease at $\sim 4R_E$ was ~ 2.5 times larger than at the surface. Variations in the field direction at $\sim 7R_E$ correlate with half-day variations in the horizontal component at the surface and in the 3-hour K index. (3) Large irregular field fluctuations with periods exceeding one minute were characteristic of the storm period. (4) The large-scale storm field was qualitatively similar to the disturbance field observed previously on non-storm days. The disturbance field appeared to evolve from quiet to disturbed conditions and then to gradually recover.

Author

N64-28376 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF COSMOGONY. VOLUME III
6 Jul. 1964 439 p refs Transl. into ENGLISH of "Voprosy Kosmogonii" Moscow, Acad. of Sci. USSR, v. 3, 1954 p 1-363
(JPRS-25359; TT-64-31632) OTS: $6.00

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N64-28377 Joint Publications Research Service, Washington, D.C.

INTERNAL STRUCTURE OF HYDROGEN PLANETS

A. A. Abrikosov *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 8–17 refs (See N64-28376 20-29) OTS: $6.00

The internal structure of hydrogen planets is discussed in terms of an equation of the state of hydrogen at high temperatures and the characteristics of hydrogen planets. G.D.B.

N64-28378 Joint Publications Research Service, Washington, D.C.

COSMOGONY OF THE PLANETARY SYSTEM AND EVOLUTION OF THE SUN

B. Yu. Levin *In its* Probl. of Cosmogony Vol. III 6 Jul. 1964 p 18–32 refs (See N64-28376 20-29) OTS: $6.00

This is a review of Soviet theories on the formation of the sun and its planetary system. Mathematical computations and observable data are presented to back these theories. G.D.B.

N64-28379 Joint Publications Research Service, Washington, D.C.

CALCULATION OF THE TRAJECTORY OF CAPTURE IN THE PLANE PROBLEM OF THREE BODIES OF EQUAL MASS

N. N. Pariyskiy *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 33–68 refs (See N64-28376 20-29) OTS: $6.00

Tables, calculations, and references to articles are presented for the case of a detachment of one of the constituents of a binary star by the gravitational attraction of a third star flying at a high velocity past the binary under consideration. G.D.B.

N64-28380 Joint Publications Research Service, Washington, D.C.

COPLANARITY OF THE ORBITS OF MULTIPLE STARS

T. A. Agekyan *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 69–97 refs (See N64-28376 20-29) OTS: $6.00

This article asserts that during formation of multiple stars, their orbits exhibit considerable coplanarity characteristics. In the course of evolution, the systems that are unstable in the sense of coplanarity are gradually losing their coplanarity characteristics. The stable systems (stable in the coplanarity sense) presently exhibit these characteristics. G.D.B.

N64-28381 Joint Publications Research Service, Washington, D.C.

MAGNETIC FIELDS IN THE INTERSTELLAR SPACE

S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 98–107 refs (See N64-28376 20-29) OTS: $6.00

This article is based on the concept that there is a magnetic field in a galaxy, but it is chaotic and is intensified by motion of interstellar gas. The origin of the initial field is discussed, as well as how the field affects the motion. G.D.B.

N64-28382 Joint Publications Research Service, Washington, D.C.

THE BILATERAL INTERACTION OF STARS WITH DIFFUSE MATTER AND ITS SIGNIFICANCE IN THE COSMOGONIC PROCESS

L. E. Gurevich *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 108–113 (See N64-28376 20-29) OTS: $6.00

Diffuse nebulas, gas absorption by a star, stars of the plane subsystems, the theory of absorption, and a theory of nova outbursts are discussed in this article. G.D.B.

N64-28383 Joint Publications Research Service, Washington, D.C.

CRITICAL REVIEW OF COSMOGONIC THEORIES PREVALENT IN WESTERN EUROPE AND AMERICA

Evri Schatzman *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 279–373 refs (See N64-28376 20-29) OTS: $6.00

This is a Soviet view of Western cosmogenic theories; stellar cosmogony, such as star mass, luminosity, spectra, and populations are examined. The evolution of stars is reviewed. The origin of stellar systems is discussed, and the origin of the solar system is critically evaluated, both from the point of view of the catastrophic and nebular theories. G.D.B.

N64-28394 Joint Publications Research Service, Washington, D.C.

FIRST PLENARY ASSEMBLY OF THE COMMISSION ON COSMOGONY

N. P. Kukarkina *In its* Probl. of Cosmogony Vol. III 6 Jul. 1964 p 399–405 (See N64-28376 20-29) OTS: $6.00

This is a report of a Soviet cosmogeny conference—who attended, what papers were read, and the comments made by prominent astronomers. G.D.B.

N64-28396 Joint Publications Research Service, Washington, D.C.

THIRD CONFERENCE ON PROBLEMS OF COSMOGONY

G. A. Leykin *In its* Probl. of Cosmogony Vol. III 6 Jul. 1964 p 412–426 (See N64-28376 20-29) OTS: $6.00

A conference on cosmogeny was held in the Soviet Union, and the events of that meeting are related in this article in terms of people, papers, and problems. G.D.B.

N64-28397 Joint Publications Research Service, Washington, D.C.

CONFERENCE ON PHYSICS OF NEBULAS AND INTERSTELLAR MEDIUM

S. B. Pikel'ner *In its* Probl. of Cosmogony. Vol. III 6 Jul. 1964 p 427–434 (See N64-28376 20-29) OTS: $6.00

Reported are the events that took place at a Soviet conference on the physics of nebulas and interstellar media. The papers read by the prominent scientists attending are briefly cited. G.D.B.

N64-28405* Virginia Polytechnic Inst., Blacksburg
PROCEEDINGS OF THE CONFERENCE ON LUNAR EXPLORATION, AUGUST 12–AUGUST 17, 1962
James B. Eades, Jr., ed. May 1963 70 p refs *Its* Bull., v. 56, no. 7, Eng. Expt. Station, Ser. 152, Suppl.
(Sponsored by NASA and NSF)

CONTENTS:
1. TOPOGRAPHY OF THE LUNAR SURFACE Zdenek Kopal (JPL) p 28 refs (See N64-28406 10-29)
2. INSTRUMENTATION FOR A LUNAR SOFT LANDER Karl W. Linnes (JPL) refs (See N64-28407 10-29)

N64-28406* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TOPOGRAPHY OF THE LUNAR SURFACE
Zdenek Kopal, Manchester U. *In* Va. Polytech. Inst. Proc. of the Conf. on Lunar Exploration, Aug. 12–Aug. 17, 1962 May 1963 28 p refs (See N64-28405 20-29)

The main point of this report is whether the bulk of the mass of the moon behaves as an elastic fluid or as a viscoelastic flow. It is assumed that the bulk of the mass of the moon consists of rocks akin to the silicates, and the results of laboratory measurements of the bulk compression modulus of the moon are employed. These results indicate that, as far as magnitude is concerned, this modulus is of the order of 10^{12} cm^2/dyn. The present estimates of the viscosity of the mantle of the earth, which are the best guides to lunar viscosity, range from 10^{22} g/cm/sec down to 10^{17} or 10^{18} g/cm/sec, which represents the lower limit. The product of these two quantities is the dimension of time. If the upper limit for the viscosity is adopted, the maximum relaxation time should come out to be of the order of 10^{10} sec, which is just about 300 years. If the lower limit is adopted, this relaxation time can be reduced to 10^6 sec, which is just about 10 days. Thus, insofar as long-drawn out process are concerned—such as probable convection is the lunar interior—the moon is almost bound to behave as viscoelastic. The superadiabatic temperature gradient would cause the matter to flow. I.v.L.

N64-28407* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
INSTRUMENTATION FOR A LUNAR SOFT LANDER
Karl W. Linnes *In* Va. Polytech. Inst. Proc. of the Conf. on Lunar Exploration, Aug. 12–Aug. 17, 1962 May 1963 38 p refs (See N64-28405 20-29)

Instrumentation design constraints for a lunar soft landing and instrumentation under study are discussed. The design constraints are vibration, shock, and acceleration; thermal control; lunar dust; and vacuum conditions. Instrumentation considered includes a gamma backscattering device for measuring material density; an instrument for measuring thermal diffusivity; moving coil geophones and a six-shot, explosive acoustic source for measuring acoustic velocity; a subsurface geophysical logging sonde for soil mechanics studies; an X-ray spectrograph; an X-ray diffractometer; a petrographic microscope; and a gas chromatograph. I.v.L.

N64-28438 Joint Publications Research Service, Washington, D.C.
MAN IN OUTER SPACE
A. M. Genin, N. N. Gurovskiy, M. D. Yemel'yanov, P. P. Saksonov, and V. I. Yazdovskiy 10 Aug. 1964 113 p Transl. into ENGLISH of the Pamphlet "Chelovek v Kosmose" Moscow, Medgiz, 1963
(JPRS-25825; TT-64-41096) OTS: $4.00

CONTENTS:
1. BASIC STAGES IN THE CONQUEST OF OUTER SPACE p 1–11 refs
2. THE LIFE-SUPPORT SYSTEMS OF COSMONAUTS IN FLIGHT p 12–35 refs
3. PROVISION OF RADIATION SAFETY p 36–69 refs
4. TRAINING OF COSMONAUTS p 70–86 refs
5. PHYSIOLOGICAL RESEARCH METHODS IN SPACE FLIGHTS p 87–105 refs

N64-28613 Aberdeen Proving Ground, Md. Ballistic Research Labs.
AN IMPROVED THEORY OF MOTION OF AN ARTIFICIAL SATELLITE
Boris Garfinkel Feb. 1964 24 p refs
(BRL-1242; AD-602694)

The paper deals with the problem of motion in the potential field defined by $V = -1/r + J_2P_2(\sin\theta)/r^3 + J_4P_4(\sin\theta)/r^5$ where J_2 and J_4 are small parameters, with $J_4 = O(J_2^2)$. The disposable constants c_1, c_2, and c_3 of the author's intermediate orbit are revised so as to incorporate the known secular variations up to the second order, furnished by the perturbation theory. The revised algorithm provides a more accurate final orbit, incorporating a substantial fraction of the Keplerian secular variations of third order. An internal check of the theory is carried out by a comparison of the natural frequencies of the orbit with those of a perturbed ellipse. Author

N64-28723* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ACCURACY OF NAVIGATION IN VARIOUS REGIONS OF EARTH-MOON SPACE WITH VARIOUS COMBINATIONS OF ONBOARD OPTICAL MEASUREMENTS
Alton P. Mayo, Robert L. Jones, and William M. Adams Washington, NASA, Sep. 1964 46 p refs
(NASA-TN-D-2448) OTS: $1.25

A study was made of the relative accuracies of 60 combinations of onboard optical observations that may be available for use in determining the position and velocity of a spacecraft from the vicinity of the earth to the vicinity of the moon. The method of analysis consisted of computing along a nominal trajectory the mathematically correct onboard-optical-observation angles for specified times, adding random errors to the optical observations, computing transition matrices, and statistically reducing the results to obtain the estimated errors in the initial position and velocity for a particular region of the trajectory. The procedure used is discussed, and the method of computation is given. Data presented show the effects of the number of observations and the frequency of observation on the accuracy of determining position and velocity. Accuracies for some of the better combinations of measurements studied are plotted over the earth–moon region. Author

N64-28741* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
MATHEMATICS OF ORBIT DETERMINATION
Joseph W. Siry Jun. 1964 15 p Presented at the Conf. on Math. Teaching, Goddard Space Flight Center, 18 Apr. 1964
(NASA-TM-X-55055; X-547-64-151) OTS: $1.60 ph

The fundamental problem of orbit determination is that of comparing theories, which have been developed to cope with the problem of determining the orbits of the planets and their natural satellites, with observational data obtained from satellite-tracking systems. Preparations for orbit determination

for the satellites to be launched during the IGY were based upon the assumption that the principal perturbations would be due to the earth's oblateness and its atmosphere. Orbit determination systems have been called upon to do many things since the space age began. There is always the interest, initially, in the early estimates of the principal orbital parameters, such as the period, the perigee and apogee heights, and the inclination. In addition, it is necessary to provide accurate predictions for the tracking and data-acquisition stations in order to insure that additional tracking and telemetry information will continue to flow. It was also necessary to furnish detailed ephemerides for the experimenters whose instruments operated in the IGY scientific satellites. In addition, orbit-determination problems that have arisen in connection with newer NASA programs are discussed. I.v.L.

N64-28762* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.

THE UPPER ATMOSPHERE OF JUPITER

S. H. Gross (Airborne Instr. Labs.) and S. I. Rascool Jun. 1964 40 p refs Submitted for Publication

(NASA-TM-X-51917) OTS: $3.60 ph

The properties of the upper atmosphere of Jupiter were theoretically investigated. The vertical temperature profile in the atmosphere above the clouds and the structure of the ionosphere were computed for two different model atmospheres: Model I corresponds to a H/He mixing ratio of 20:1 by volume, and Model II has a H/He ratio as low as 0.03:1. Assuming that the atmosphere of Jupiter above the clouds is in radiative equilibrium, the temperature distribution in the upper atmosphere of Jupiter was computed. With a cloud top temperature of 153° K and the total optical thickness of the atmosphere in the far infrared of 0.66, the radiation emitted by the planet is 3.1×10^4 ergs cm^{-3} sec^{-1}. This value of radiation flux is ~ 4 times higher than the solar flux received by Jupiter. The equilibrium distribution of electron densities in the ionosphere of Jupiter was also calculated. The maximum electron densities of ~ 10^6 electrons/cc occurred at the altitudes of 220 km and 110 km above the cloud top for the two model atmospheres. Author

N64-28830* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PROGRAM MANUAL FOR MINIMUM VARIANCE PRECISION TRACKING AND ORBIT PREDICTION PROGRAM

D. S. Woolston and John Mohan 1 Jul. 1963 107 p refs

(NASA-TM-X-51928; X-640-63-144) OTS: $9.10 ph

A prototype version of a computing program for orbit determination based on an extension of the Schmidt–Kalman variance technique for processing tracking data is described. For the purpose of predicting position as a function of time, the program uses Encke's form of the differential equations of motion. It solves analytically the best local two-body problem and numerically integrates the deviation from this two-body reference trajectory. When the true trajectory departs from the reference orbit by preset limits, a rectification is performed; that is, the current true radius and velocity vectors are used to define a new reference path. The Schmidt–Kalman method of minimum variance used relates the present estimate of the state variable deviation to the present actual deviation in the observations, in contrast to the methods of least squares or weighted least squares that relate the estimate of the initial parameters to an entire sequence of observational residuals. M.P.G.

N64-28840* IIT Research Inst., Chicago, Ill. Astro Sciences Center

THE ACCESSIBLE REGIONS METHOD OF ENERGY AND FLIGHT TIME ANALYSIS FOR ONE-WAY BALLISTIC INTERPLANETARY MISSIONS

F. Narin 22 Jun. 1964 58 p ref

(Contract NASr-65(06))

(NASA-CR-58359; T-6) OTS: $5.60 ph

The accessible regions method plots contours of ideal velocity in a plane P_N normal to the ecliptic plane and intersecting it at the sun. This is a side view of the solar system. For any point in P_N there is some minimum energy required to place a given payload at that point; by determining this energy for enough points it is possible to construct contours of minimum ideal velocity to reach any point in P_N. These contours are equivalent to constructing contours that show the minimum ideal velocity required to reach any point in the solar system. It is also possible to construct variations of the minimum ideal velocity contours; these contours show the effects of constraints, such as time of flight, on the regions accessible to a launch vehicle. Author

N64-28853* Rensselaer Polytechnic Inst., Troy, N.Y.

ANALYTICAL SOLUTIONS FOR MANNED LUNAR LANDING TRAJECTORIES

C. N. Shen [1964] 29 p refs Presented at XVth Astronautical Congr., Warsaw, Sep. 1964

(Grant NsG-14-59)

(NASA-CR-58630) OTS: $2.60 ph

A continuous thrust program for a single engine is employed in this article for the entire descent phase of a vehicle from an orbit. The weight of a retrorocket is generally proportioned to its rated thrust. The optimization problem of the combined mass of fuel and engine is approached approximately. All computational solutions are in closed algebraic form enabling an astronaut to operate the vehicle and determine his own course if manual operation is preferred. A.W.

N64-28896* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GODDARD ORBIT INFORMATION SYSTEMS

Joseph W. Siry Jun. 1964 26 p

(NASA-TM-X-55044; X-547-64-108) OTS: $2.60 ph

The Goddard Space Flight Center issues bulletins that give the general characteristics of satellite orbits as well as information designed to be useful for prediction purposes. Key features of the various types of orbital information furnished are described. The discussion includes descriptions of systems of space elements, and conventions concerning time, orbit and revolution numbers, topocentric coordinates, ephemerides, and viewing predictions for readily visible satellites. D.S.G.

N64-28943* Rensselaer Polytechnic Inst., Troy, N.Y.

ANALYTICAL SOLUTIONS FOR MANNED LUNAR LANDING TRAJECTORIES

C. N. Shen [1964] 28 p refs Presented by XVth Intern. Astron. Congr., Warsaw, 7–12 Sep. 1964

(Grant NsG-14-59)

(NASA-CR-58683) OTS: $2.60 ph

This paper deals with a set of guidance equations for powered descent in vacuum. A continuous thrust program for a single engine is employed for the entire descent phase of a vehicle in a vacuum. The weight of a retrorocket is generally proportional to its rated thrust. The optimization problem of

the combined mass of fuel and engine is approached approximately. The guidance and control system can be carried by the space vehicle to eliminate the inherent delay of an earth-bound radio command system (2.56 seconds round trip). All necessary special computers will be sufficiently simple and small for space travel because all computational solutions are in closed algebraic form, thus enabling an astronaut to operate the vehicle and determine his own course if manual operation is preferred. Author

N64-28944 Observatorium Bosscha, Bandung (Indonesia)
EFFECTS OF METEOR-IMPACTS ON STATIONARY SATELLITES
K. Purbosiswojo Repr. from Proc. Bandung Inst. of Tech., v. 3, no. 2, 1964 6 p *Its* Contrib. No. 25
(Sponsored by Indonesia Dept. of Natl. Res.)

The changes of the orbital elements of stationary satellites due to meteor impacts are discussed. From these changes in principle it should be possible to determine whether or not there exists a correlation between meteor mass and velocity. It has been shown here how to detect and estimate an increase in space density and in the velocity vector of any meteor stream T, traversed by the satellite. Numerical results, however, show that effects of meteor impacts can be neglected. Author

N64-28994* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ORBIT DETERMINATION FOR A LUNAR SATELLITE
Jack Lorell Repr. from J. Astron. Sci., v. XI, no. 1, Spring 1964 p 1–7 refs
(Contract NAS7-100)
(NASA-CR-58450; JPL-TR-32-483)

The orbit determination problem for a lunar satellite is examined from the point of view of geometric determinacy of the data. Various data-type combinations are considered, including radar range, radar range rate, and optical. Using appropriate coordinate systems, it is shown how the condition equations may be set up and how the number of data points required for solution may be calculated. It is also shown how these considerations are related to the statistical problem of determining the orbit from noisy data. Author

N64-28997* New Mexico State U., University Park
[PHOTOGRAPHIC PATROL AND STUDY OF THE PHYSICAL CONDITIONS ON THE MOON AND PLANETS, INCLUDING PHOTOELECTRIC AND SPECTROGRAPHIC STUDIES] Annual Report, 1 Jul. 1963–30 Jun. 1964
Clyde W. Tombaugh [1964] 29 p
(Grant NsG-142)
(NASA-CR-58617) OTS: $1.10 ph

Six hundred and ninety-two plates of Venus were taken on 172 days. The inferior conjunction in June 1964 was well covered, with 212 plates being taken in ultraviolet, blue, green, and infrared light during 5 weeks. A total of 890 plates were taken of Jupiter, on 198 nights, in blue, green, red, ultraviolet, and infrared, in order of abundance. A perihelic opposition of Jupiter occurred during this reporting period. A large number of Jupiter images were reduced for size of markings and zenographic coordinates. A total of 18 plates were taken of Saturn in blue and red light, in equal number. A total of 77 plates were taken of sections of the Moon. Thirty-five plates and 14 sheets of Ektachrome were taken of Aristarchus in blue and red light. Five plates were taken of Mare Tranquillitatis for the impact of Ranger VI. In addition, visual observations were made of approximately 100 Jovian markings, located in 15 different atmospheric currents, and of Aristarchus for possible signs of activity. I.v.L.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-28100 Tokyo U. (Japan) Aeronautical Research Inst.
ON THE DYNAMIC STABILITY OF ROCKETS
Bunji Tomita Mar. 1964 38 p refs *Its* Rept. 385 (Vol. 29, No. 7)

The general equations of motion are derived for spinning elastic rocket with respect to axes attached to the rocket. The equations contain a force and moment system that includes, in addition to the usual quasi-steady forces and moments, those due to Magnus effects. As a result, the stability criteria for spinning elastic rocket are approximately derived, including the case of rigid body and of the nonspinning elastic rocket. Comparing these analytical results with the digital computational results, the applicability of these stability criteria is examined and, from these results, empirical formulas for stability boundaries are presented. Author

N64-28306* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MISSION APPLICATIONS OF ORBITAL AND GLOBAL RANGE TRANSPORTS
H. H. Koelle N.Y., AIAA, [1964] 15 p refs Presented at the (Secret) AIAA Mil. Aircraft Systems and Technol. Meeting, Washington, 21–23 Sep. 1964
(AIAA Paper-64-770) AIAA: $0.50 members; $1.00 nonmembers

Reusable space vehicles are defined and classified as earth orbital transports, global range transports, and interorbital ferry vehicles. The primary advantages and disadvantages of reusable space vehicles are summarized, resulting in six basic design criteria. Seventeen potential civilian and military applications of earth orbital and global transports are discussed in some detail. The commercial application of a global transport has the largest potential market and, therefore, should govern the development of the systems specifications of a reusable transport, which could serve both the earth orbital and global markets. It is practical and feasible to develop one system compatible with the mission requirements for both applications. Author

N64-28580 Mitre Corp., Bedford, Mass.
A RE-ENTRY VEHICLE SIMULATION DESIGNED FOR THE STUDY OF GROUND SYSTEM REQUIREMENTS
P. J. Plender Jul. 1964 74 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-135; TM-03973; AD-603714)

A computer simulation of reentry vehicle trajectories was developed as an aid in determining the requirements of supporting ground-based electronic systems. This report describes the mathematical model used in the simulation and discusses, with the aid of examples, the usefulness of the output data in the preliminary design of tracking and communications networks. Author

N64-28657 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE EFFECTIVENESS OF DIFFERENT METHODS OF REDUCING THE DISPERSION OF EXPERIMENTAL MISSILES [EFFICACITE DE DIFFERENTS PROCEDES POUR REDUIRE LA DISPERSION DES MISSILES EXPERIMENTAUX]
M. Bismut London, Min. of Aviation, May 1964 21p Presented at AGARD Specialists Meeting on "The Use of Rocketpowered Vehicles in Flight Res.," Scheveningen, The Netherlands, 18–21 Jul 1961
(AGARD-392; RAE-LIB-TRANS-1065)

The dispersion of experimental missiles constitutes a hazard of increasing importance as the performance is raised. A number of causes of dispersion together can make the launch of a missile particularly critical, and certain methods can be used to minimize these effects. Even if the characteristics are carefully chosen an uncontrolled missile can produce unacceptable deviations. A certain amount of roll, produced by spin rockets proves relatively effective and allows obtaining an accuracy in the initial slope of the trajectory of the order of 1°. A better accuracy than this can be attained by means of automatic attitude control, using auxiliary jets and a relatively simple servomechanism. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-28329* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETAILED DESCRIPTION AND FLIGHT PERFORMANCE OF THE RAM B VEHICLE
James L. Raper, Robert J. Keynton, and Gerald E. Woodbury Washington, NASA, Sep. 1964 99 p refs
(NASA-TN-D-2437) OTS: $2.25

A general description of the performance of the second flight of the RAM B vehicle and some selected details of the mechanical design and fabrication of the RAM B vehicle were presented. The purpose of the B series flight tests was to probe the radio blackout region, to correlate and modify ionization attenuation theories, and to evaluate the effectiveness of methods for overcoming signal attenuation. The RAM B vehicle fulfilled its intended mission requirements. The flight-test results showed that the overall vehicle structural design, heat shielding, and payload-stage configuration survived the unique conditions associated with the high-temperature, jet-pluming instability environment encountered during the flight. The vehicle successfully followed the approximate nominal trajectory and achieved a velocity of 17,860 ft/sec at an altitude of 162,000 ft. Flight date discussed include velocity, altitude, accelerations, and roll rates. Angle-of-attack and component temperature histories are also presented but are not analyzed. Author

N64-28527 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE OPTIMALITY OF MULTISTAGE ROCKETS
O. F. Makarov 14 Jun. 1963 14 p refs Transl. into ENGLISH from Aviatsionnaya Tekhnika (USSR), No. 4, 1962 p 18–26
(FTD-TT-63-427/1+2+4; AD-412884)

Investigations of the optimality of multistage rockets usually are limited to obtaining the necessary conditions of extremality, without considering the question of satisfying sufficient conditions. Consideration is given to the questions of sufficiency for motion without consideration of the action of external forces, as well as to certain questions of necessity and sufficiency during motion in a gravitational field. Author

N64-28806 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
THE REUSABLE BOOSTER FOR LUNAR LOGISTICS AND PLANETARY EXPLORATION
Phil Bono, J. L. Woodworth, and G. A. Ursini [1964] 24 p refs Presented at the 15th Intern. Astronautical Federation Congr., Warsaw, 7–12 Sep. 1964
(Douglas Paper-1887)

To obtain a realistic appraisal of payload capability and weight, the paper adopts a hypothetical orbital booster, which is Earth-recovered on four landing legs, as a representative lunar cargo carrier. An evaluation of its mission potential is conducted, based on the assumption that the conjectural orbital booster can be refueled in Earth orbit. An operational sequence is delineated for Earth-orbit retanking, for landing on the lunar surface, and for eventual return to Earth. The hypothetical land-recovered booster is initially sized to deliver an 800,000-lb. payload to a 300-nmi Earth orbit. Results of a payload-size evaluation are presented, which confirm the necessity for a vehicle with post-Saturn-class payload capability. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-27966 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE MOTION OF AN ARTIFICIAL EARTH SATELLITE IN A NON-SPHERICAL ATMOSPHERE [DVIZHENIE ISKUSSTVENNOGO SPUTNIKA ZEMLI V NESFERICHESKOI ATMOSFERE]
A. M. Fominov London, Min. of Aviation, May 1964 40 p refs Transl. into ENGLISH from Byull. Inst. Teor. Astron. (USSR), v. 9, no. 3 (106), 1963 p 185–203
(RAE-TRANS-1066)

The distribution of the density of the air in the earth's atmosphere is given by the formula

$$\rho = \rho_1\left|1 + \sum_{n=1}^{\infty}\alpha_n P_n(\sin\phi) + \sum_{n=1}^{\infty}\beta_n P_n(\cos\psi)\right|,$$

where ρ_1 is the density of a spherically symmetrical atmosphere, $P_n(x)$ is a spherical Legendre polynomial of the nth

order of argument x, ϕ is the latitude, ψ is the angular geocentric distance from the center of the diurnal effect, α_n and β_n are coefficients that characterize the latitude and diurnal effect in the distribution of the air density and are usually dependent on the distance to the earth's center. This assumed model of the atmosphere makes it possible to treat the latitude effect in the distribution of the air density as a particular case of the diurnal effect. With this model of the atmosphere equations are derived for the changes in the orbital elements of the satellite during one revolution about the earth on the condition that the coefficients α_n and β_n are constants. Author

N64-28074* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DESCRIPTION AND OPERATION OF SPACECRAFT IN SERT I ION THRUSTOR FLIGHT TEST
Harold Gold, Raymond J. Rulis, Frank A. Maruna, Jr., and William H. Hawersaat Washington, NASA, 1964 20 p refs
(NASA-TM-X-53050) OTS: $1.60 ph

The SERT I spacecraft was flown into a ballistic trajectory by the Scout launch vehicle. The trajectory provided an experimental period of 47 minutes, during which the altitude of the spacecraft was above 250 nmi. The spacecraft carried two small ion thrustors and telemetered measurements of all major thrustor operating parameters. One of the thrustors operated for approximately 30 minutes, during which time the measured thrustor verified the establishment of a neutral ion beam. Author

N64-28119 Massachusetts Inst. of Tech., Cambridge
MIT—AOAO, AN ADVANCED ORBITING ASTRONOMICAL OBSERVATORY A STUDENT PROJECT IN SYSTEMS ENGINEERING, SPRING TERM, 1964
1964 269 p refs

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N64-28233* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF GROUND TESTS AND ORBITAL LAUNCH RESULTS FOR THE EXPLORER IX AND EXPLORER XIX SATELLITES
Charles V. Woerner and Claude W. Coffee, Jr. Washington, NASA, Sep. 1964 27 p refs
(NASA-TN-D-2466) OTS: $0.75

A study has been made of the flight-test results for the launch and orbiting of the 12-ft-diam inflatable spheres, Explorer IX and Explorer XIX. The two flight tests have demonstrated that, in general, the in-flight operation of the ejection and inflation system was similar to that experienced during environmental tests and that a lightweight delicate structure can be erected in space after withstanding the severe conditions imposed by an orbiting spin-stabilized launch vehicle. The two flight tests demonstrated that the longitudinally unrestrained folded sphere does not eject prematurely. The apparent magnitude, as reported by various Moonwatch teams, has shown very good agreement with theoretical calculations for an inflatable structure of this type. Author

N64-28318* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC AERODYNAMIC AND BUFFET CHARACTERISTICS OF A PACKAGED SPACE STATION IN COMBINATION WITH A SATURN V LAUNCH VEHICLE
C. Robert Carter Washington, NASA, Sep. 1964 34 p refs
(NASA-TM-X-1000) OTS: $1.00

A wind-tunnel investigation was conducted to determine the transonic aerodynamic and buffet-pressure characteristics of a launch configuration model of a packaged, manned orbital space station in combination with a modified Saturn V launch vehicle. The tests were conducted at Mach numbers from 0.50 to 1.20, and over a range of angles-of-attack from −6° to 16°. The results of this investigation indicate that the aerodynamic characteristics of the complete vehicle were not significantly affected by the presence of the packaged space station. The normal-force and axial-force contributions of the packaged space station were approximately 55% of the total over the Mach number range. The largest buffet pressures measured on the packaged space station were only about 10% of the free-stream dynamic pressure. Author

N64-28342* National Aeronautics and Space Administration, Washington, D.C.
RANGER VII A Special Report
5 Aug. 1964 36 p
GPO: $0.30

A special report on the near-perfect flight of Ranger VII that ended as planned with impact on the moon within 10 miles of the predicted impact point is presented. The photographic system performed to the limit of its design capability, delivering 4,316 pictures described as having a clarity and definition a thousand times better than those available from earth-based telescopic cameras. A series of these photographs is presented, illustrating the nesting technique used so that each photograph shows, in greater detail, an area within the preceding picture. Also included are the flight chronology from launch on July 28 to impact on July 31, 1964; NASA's mandate for lunar exploration; description of Ranger Spacecraft; Ranger Fact sheet; launch-vehicle details; a list of personnel associated with the project; and samples of U.S. and world press reactions. M.P.G.

N64-28670 Aerospace Corp., El Segundo, Calif. Electronics Div.
MOMENTUM BIAS ATTITUDE CONTROL FOR A SYNCHRONOUS COMMUNICATION SATTELLITE
A. C. Barker 30 May 1964 75 p
(Contract AF 04(695)-269)
(TOR-269(4540-70)-1; AD-601807)

This study establishes the analytic feasibility of achieving adequate long-life attitude stabilization, using only the gyroscopic effect of a large pitch momentum for attenuation of roll and yaw errors. In addition, it is shown that momentum buildup in pitch will be small enough so that all corrections in pitch attitude can be made by varying the wheel speed. Thus, the entire system can operate for the required 3 years after initial acquisition without the use of gas and with only a single active control loop. Two special, but easily implemented, maneuvers will be required to achieve these results. First, during lifetime station-keeping operations, it will be necessary to add one-half the velocity increment at t_0 and to add the other half 12 hours later. Second, the execution of a daily 180° yaw turn, alternating the direction of vehicle rotation each day, must be implemented. The damper mechanization defined in this study is simple and provides for very rapid decay of vehicle nutation. The appendixes present coordinate systems and transformation matrices, and the equations of motion.
I.v.L.

N64-28711* National Aeronautics and Space Administration, Washington, D.C.
INTERPLANETARY EXPLORER SATELLITES
[1964] 1 p
(NASA Facts, Vol. II, No. I) GPO: $0.15

Basic facts are presented about the Interplanetary Explorer series of satellites, the first of which, Explorer XVIII, was launched Nov. 26, 1963. These satellites are aimed primarily at acquiring additional knowledge about radiation and magnetic fields in space between the earth and moon during a major part of the solar cycle. A description of Explorer XVIII, its communications and power system, orbital information, and tracking by the new Satellite Tracking and Data Acquisition Network (STADAN) is included. Preliminary analyses of data from Explorer XVIII have provided significant information about a shock wave that envelops the earth, and about a band of radiation lying above the Van Allen region. M.P.G.

N64-28725* Harvard Coll. Observatory, Cambridge, Mass.
ATMOSPHERIC HEATING IN THE AURORAL ZONES: A PRELIMINARY ANALYSIS OF THE ATMOSPHERIC DRAG OF THE INJUN 3 SATELLITE
Luigi G. Jacchia and Jack Slowey (Smithsonian Astrophys. Obs.) Repr. from J. Geophys. Res., v. 69, no. 5, 1 Mar. 1964 p 905–910 refs Previously Published as NASA-CR-52456; see N64-10136 01-02 Harvard Repr. 648
(Grant NsG-87-60)

Injun 3 is a near-spherical object in an orbit with eccentricity 0.16, inclination 70.4°, and a mean perigee height of 250 km. An analysis of the drag during the first half-year after launching revealed that on geomagnetically quiet days the upper-atmosphere temperature in the auroral zones is essentially the same as at the equator, and that the heating accompanying geomagnetic perturbations in the auroral zones is 4 or 5 times greater than the heating experienced during these perturbations in low latitudes. In addition, the present analysis gives a calibration of atmospheric models at the critical height of 250 km. The amplitude of the diurnal temperature oscillation is smaller than was expected, but the cause of the discrepancy may lie in part with the atmospheric model. Author

N64-28763* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 4, NO. 14
31 Jul. 1964 29 p
(NASA-TM-X-51909; X-533-63-1) OTS: $2.60 ph

This report lists objects that were launched during the years 1958 through 1964. It also lists decayed objects launched during the years 1957 through 1964. I.v.L.

N64-28807 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
"PEGASUS"—A DESIGN CONCEPT FOR A V.I.P. ORBITAL/GLOBAL ROCKET TRANSPORT
Phil Bono, G. C. Goldbaum, and R. M. Wood 7 Oct. 1964 27 p refs Presented at the SAE Natl. Aeron. and Space Meeting, Los Angeles
(Douglas Paper-1980)

A new class of carrier for high-income passengers and high-priority cargo may evolve from the reusable booster of tomorrow. This paper describes the results of a study to determine the operational and economic aspects of such a potentially feasible vehicle. Evolution of the hypothetical transport system, termed Pegasus, is based on the premise that after vehicle survival of atmospheric penetration has become commonplace, a reusable booster of the Saturn V payload class (100 tons to orbit) may be developed and adapted for ballistic surface-to-surface payload delivery. The Pegasus global transport vehicle (a VTOL rocket) with a Saturn V orbital capability could be adapted to deliver 170 passengers and 18 tons

of cargo to any point on the earth within 45 minutes at average speeds of 17,000 mph, without subjecting the passengers to any more than 3 g's during boost or entry. The vehicle could be operational by the early 1980's. I.v.L.

N64-28897* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ORBITING SOLAR OBSERVATORY SPACECRAFT
F. P. Dolder, O. E. Bartoe, R. C. Mercure, Jr., R. H. Gablehouse (Ball Bros. Research Corp.), and J. C. Lindsay Apr. 1964 18 p Presented at the Am. Geophys. Union, Wash., Apr. 1963
(Sponsored by NASA)
(NASA-TM-X-55038; X-610-64-86) OTS: $1.60 ph

The first Orbiting Solar Observatory (OSO-1) was launched March 7, 1962, from the Atlantic Missile Range. This spacecraft was designed to point approximately 75 lb of instruments at the sun with an accuracy of about 1 minute of arc. It accommodates an additional 100 lb of instruments carried in a spinning section of the satellite, which sweeps across the sun every 2 seconds. The total weight of the spacecraft is 458.3 lb. In orbit it is 92 in. in diameter and 37 in. high. The spacecraft has on board data-recording capability that can store 90 minutes of data. These data are played back over the spacecraft's transmission system in 5 minutes upon ground command. The spacecraft is in an almost perfect 300-nmi circular orbit inclined 32.8° to the equator. The spacecraft has worked perfectly since injection into orbit, and at the time of this writing has completed over 1,000 orbits. The pointing system has pointed the instruments at the sun with an accuracy of approximately 2 minutes in azimuth angle and 2.5 minutes in elevation. The temperature inside the satellite has stabilized to 5° C. Excellent radio transmission was received from the spacecraft. Author

N64-28929* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRONIC PERFORMANCE OF THE S-52 PROTOTYPE SPACECRAFT UNDER THERMAL-VACUUM EXPOSURE
H. Leverone and N. Mandell 9 Jul. 1963 107 p
(NASA-TM-X-55039; X-320-64-52) OTS: $9.10 ph

The S-52 prototype spacecraft performed as intended, except for anomalies that are shown in a table. Modifications of the S-52 prototype spacecraft to correct these anomalies were verified in the subsequent solar-simulation exposure. The data collected, calibrations performed, and analysis made, to evaluate the performance of the spacecraft throughout the exposure, are included. Test procedures and instrumentation used are also covered. Author

N64-28969* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SURVEYOR LANDER MISSION AND CAPABILITY
Milton Beilock 1 Aug. 1964 26 p
(Contract NAS7-100)
(NASA-CR-58247; JPL-TR-32-618) OTS: $2.60 ph

The organization, purpose, and general engineering nature of the Surveyor lunar soft-lander project is reviewed in the context of unmanned lunar exploration and anticipated needs of manned lunar programs. Flight and lunar-surface operations are discussed for both the test missions and the operational missions. An estimate of the nature and capability of the engineering payload and of each experiment of the scientific payload is presented. Finally, a brief discussion of the possibilities of follow-on missions is given. Author

N64-28972* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-28, VOLUME VI FOR THE PERIOD MAY 1, 1964 TO JUNE 30, 1964. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Jul. 1964 60 p ref
(Contract NAS7-100)
(NASA-CR-58546; JPL-SPS-37-28, Vol. VI) OTS: $5.60 ph

Reports on the following space exploration programs and related supporting research are presented: Lunar Program, including Ranger and Surveyor spacecraft systems; Planetary-Interplanetary Program, emphasizing the Mariner spacecraft; Deep Space Network, including tracking, communications, and advanced antenna system at the Deep Space Instrumentation Facility; Space Sciences, including space instruments development and applied science. M.P.G.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-27982 Joint Publications Research Service, Washington, D.C.
CALCULATION OF A VERY LONG CYLINDRICAL SHELL BY THE METHOD OF SUPERPOSITION
D. A. Royak *In its* Eng. J., No. 1, 1964 28 Jul. 1964 p 64-76 refs (See N64-27976 20-23) OTS: $5.00

Derived in this calculation of a very long cylindrical shell by the method of superpositon are formulas for determining the effect of a concentrated force during the calculation of a ring and shell; general formulas for determining radial shift; an approximation of radial shift under the action of a radial force; and the calculation of the formula for determining the radial shift under the action of radial forces. Also, several specific examples of the calculation of a cylindrical shell according to the method of superposition are given. I.v.L.

N64-28097 Tokyo U. (Japan) Aeronautical Research Inst.
A METHOD OF DISCUSSION OF THE ELASTIC STABILITY IN NON-LINEAR SNAP BUCKLING (SNAP BUCKLING OF CIRCULAR PLATES DUE TO RAPID HEATING OR COOLING)
Masuji Uemura Mar. 1964 21 p refs *Its* Rept. 384 (Vol. 29, No. 6)

In order to investigate the stability condition of certain equilibrium states existing in the nonlinear buckling phenomenon as a result of finite deformation, and in order to specify a reasonable deformation process, a method of analysis of the stability criterion in two-dimensional plates or shells is presented. This method is applied to a sample problem concerning the snap buckling of circular plates due to rapid heating or cooling and is found to be of use, especially when the Euler equation derived from the variational method is solved by the progressive approximation method. Since the effect of the temperature gradient through the thickness resulting from the rapid heating or cooling corresponds to the action of a pressure over the surface, it should be noted that a snap buckling may be induced by this effect, even if there is no initial deflection. Author

N64-28101 Tokyo U. (Japan) Aeronautical Research Inst.
ANALYSIS OF THE PLASTIC WAVE PROPAGATION IN HIGH VELOCITY TENSION OF A BAR OF FINITE LENGTH (I. RIGID-LINEARLY WORK HARDENING MATERIAL)
Kozo Kawata, Shinji Fukui, and Jiro Seino Mar. 1964 13 p refs
Its Rept. 389 (Vol. 29, No. 11)

The mechanical behavior of a bar of finite length in high-velocity tension is analyzed using characteristics based upon strain-rate independent theory, assuming rigid, linearly work-hardening material properties. In this case, the solution to the relation of breaking strain ϵ_b versus tensile velocity V_1 can be obtained for the whole range of V_1, though it does not exist for the values of V_1 smaller than critical impact velocity V_{cr}, in the case of a bar of semi-infinite length. The critical impact velocity exists in this case also and coincides with the value derived by Kármán in the case of semi-infinite length. Author

N64-28131 Lockheed-California Co., Burbank
DEVELOPMENT OF A POWER SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT Monthly Progress Report, 1–31 Jul. 1964
F. M. Hoblit, N. Paul, and F. Ashford 8 Aug. 1964 81 p refs
(Contract FA-WA-4768)
(MPR-5)

Work included dynamic analysis and generation of design conditions from statistically defined loads for the vertical gust, as well as the determination of a mathematical model for the lateral gust. R.T.K.

N64-28155 Aberdeen Proving Ground, Md. Ballistic Research Labs.
THE RESPONSE OF CYLINDRICAL SHELLS TO EXTERNAL BLAST LOADING. PART II
William J. Schuman, Jr. May 1964 119 p refs
(BRL Memo 1560; AD-444335)

In this report, data obtained from additional firings at Aberdeen Proving Ground and from the large-scale firings of Project Big Bird at the Yuma Proving Ground are presented. The empirical relations were modified to incorporate these data. A comparison of predicted and actual over-pressure values resulting in deformation (5% to 10% of original diameter) for 133 data points yields an average deviation of ±12%. Author

N64-28157 Aberdeen Proving Ground, Md. Ballistic Research Labs.
TRANSIENT HYPERVELOCITY IMPACT PHENOMENA IN A TRANSPARENT TARGET
Vincent M. Boyle May 1964 15 p refs
(BRL-Memo-1567; AD-444334)

The transient shock pressure in a transparent target subjected to hypervelocity impact was calculated from streak camera measurements of shock velocity in the target. An elongated aluminum projectile traveling 9.5 km/sec and a steel disc traveling 4.6 km/sec were fired for comparison. In both cases the extremely high pressures produced at the instant of impact dropped very rapidly. The elongated projectile caused a region of nearly steady-state penetration in which the pressure at the shock front was sustained at a somewhat lower value for a lengthened period of time. Author

N64-28254 Argonne National Lab., Ill.
BENDING OF CIRCULAR PLATES UNDER A VARIABLE SYMMETRICAL LOAD
J. C. Heap Apr. 1964 32 p refs
(Contract W-31-109-ENG-38)
(ANL-6882) OTS: $0.75

The basic equations of deflection, slope, and moment for a thin, flat, circular plate, under a symmetrical variable load, for a constant force divided by the square of the radial distance, were developed. Six cases were derived. The first four cases cover the variable load acting over the entire plate—fixed, supported, outer edge and fixed, inner edge; simply supported, outer edge and free, inner edge; simply supported, outer edge and fixed, inner edge; fixed, supported, outer edge and free, inner edge. The final two cases are for a solid plate having the acting variable load bounded by circles of an inner radius and the outer support-load radius—fixed, supported, outer edge; and simply supported, outer edge. Author

N64-28257 Italy Ministero Difesa Aeronautica, Rome Direzione Generale Costruzioni e Approvvigionamenti
MINUTES OF THE EIGHTH CONFERENCE OF THE INTERNATIONAL COMMITTEE ON AERONAUTICAL FATIGUE
V. Villa [1963] 271 p refs Conf. Held in Rome, Apr. 1963
(ICAF-271)

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N64-28258 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
INTERNATIONAL COMMITTEE ON AERONAUTICAL FATIGUE (ICAF), REVIEW OF THE PERIOD MAY 1961 TO APRIL 1963 WITH AN INTRODUCTION ON THE FIRST TEN YEARS OF ICAF

F. J. Plantema *In* Italy. Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 11–17 (See N64-28257 20-33)

The purposes of ICAF are these: (1) exchange on the largest possible scale of reports and other information on the experiences gained (test results, testing methods, equipment, etc.); (2) exchange of information at the earliest possible date on proposed investigations, progress of running tests, etc; and (3) the establishment of a common research program, the main purpose being to avoid unnecessary duplication of work and to profit from specialized experience. Conferences and symposiums are discussed as well as documents exchanged during the period under review. Some subjects given considerable attention are fatigue testing under random and programed loading, crack propagation and residual static strength, the fatigue strength of various types of joints, and load spectra. Apart from these, there were papers on subjects such as studies of a physical or statistical nature, investigation of fracture surfaces, elevated-temperature fatigue, etc. The collaboration of ICAF with AGARD is emphasized. I.v.L.

N64-28259 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

A REVIEW OF WORK IN THE UNITED KINGDOM ON THE FATIGUE OF AIRCRAFT STRUCTURES DURING THE PERIOD MAY 1961–APRIL 1963

E. L. Ripley *In* Italy. Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 19–34 refs (See N64-28257 20-33)

Work in the following areas is summarized: (1) fatigue loading actions; (2) fatigue research—programed loading, methods of cumulative damage prediction, crack propagation, surface finish, interference-fit bushes for increasing the fatigue endurance of joints, fretting, and fatigue at elevated temperatures; (3) creep research—overaging under stress, creep behavior under varying tensile stress, creep tests in bending and in compression, creep tests on specimens with stress concentrations, and the development of automatic recording equipment; (4) fatigue and creep design data on materials and structural elements; and (5) full-scale fatigue tests, particularly on wings. I.v.L.

N64-28260 Eidgenossisches Flugzeugwerk Emmen (Switzerland)

A REVIEW OF WORK IN SWITZERLAND ON THE FATIGUE OF AIRCRAFT STRUCTURES DURING THE PERIOD MAY 1961 TO MARCH 1963

J. Branger *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 37–67 refs (See N64-28257 20-33)

Work on aircraft fatigue in the following areas is discussed: (1) gust investigation—the gust profile over the Swiss countryside during stormy weather conditions, the effect of gusts on aircraft wings considering them as elastic bodies, and the existence of areas of the country especially endangered by gusts; (2) statistics of fatigue loads; (3) the development of the rig for full-scale fatigue tests; (4) full-scale fatigue tests on the DH 112 VENOM aircraft; and (5) the design of a crack detector of high sensitivity. I.v.L.

N64-28261 Service Technique de l Aeronautique (Belgium)

REVIEW OF THE BELGIAN S.T.Ae. INVESTIGATIONS ON AERONAUTICAL FATIGUE DURING 1961 AND 1962

J. Van Laer *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 69–90 (See N64-28257 20-33)

The following investigations are discussed: (1) the effect of electrical markings on a Cr-Mo steel (35 CD 4), heat-treated to 105 kg/mm^2, for the purpose of determining if the results are as well marked as in the case of high-strength steel; (2) the effect of the mechanical finish of the interior surface of a hole made in a 24 ST sheet specimen; (3) the effect of a brief heating period of 30 minutes at temperatures of 200°, 250°, and 300° C on specimens made of the aluminum alloy 2024 ST-6; and (4) the cumulative damage, in fatigue, on over 4,000 specimens of Cr-Mo (35 CD 4) steel; and (5) the endurance of high-strength shear pins. I.v.L.

N64-28262 Aeronautical Research Labs., Melbourne (Australia)

A REVIEW OF AUSTRALIAN INVESTIGATIONS ON AERONAUTICAL FATIGUE DURING THE PERIOD MAY 1961 TO MARCH 1963

C. A. Patching and J. Y. Mann *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 93–115 refs (See N64-28257 20-33)

This review is divided into 10 main sections as follows: general, investigations on materials, fatigue characteristics of complete structures and components, flight load research, fatigue life assessment, fatigue crack propagation, fatigue problems in service and design criteria, development of equipment and testing techniques, proposed fatigue research, and publications. Author

N64-28263 Aeronautical Research Inst. of Sweden, Stockholm

REVIEW OF SOME SWEDISH INVESTIGATIONS ON FATIGUE DURING THE PERIOD MAY 1961 TO MARCH 1963

G. Wallgren *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 119–140 (See N64-28257 20-33)

The work reviewed is of a theoretical and experimental nature. The latter has, to a large extent, been ad-hoc tests on materials and structural components. The fatigue investigations that have been carried out deal with the following items: (1) fatigue-crack propagation; (2) the probability of collapse of a fail-safe structure consisting of parallel elements; (3) fatigue tests on light-alloy lugs loaded perpendicular to the longitudinal direction of the lugs; (4) a study of methods for delaying the propagation of a fatigue crack in sheet material; (5) the study of fatigue properties of high-strength steels; and (6) the fatigue strength of specimens taken in the transverse direction from thick bars of extruded 2024S-T material and rolled Cr-Mo steel. Also, the acoustical-fatigue test facility is described. I.v.L.

N64-28264 Etablissement Aeronautique de Toulouse (France)

REPORT OF THE FATIGUE TESTS MADE IN FRANCE ON AIRCRAFT MATERIALS AND STRUCTURES DURING 1961 AND 1962

L. Laborde *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 143–167 (See N64-28257 20-33)

Fatigue tests conducted on aircraft materials and structures are discussed. These tests cover the following: (1) the determination of the fatigue characteristics of alloys; (2) the investigation of the influence of different parameters (surface finish, grain size, elevated temperature, welds, etc.) on the fatigue behavior of metals; (3) the investigation of means for assembling elementary structures (tubes, bolts, sheets, etc.); and (4) tests on assemblies and elementary structures (spars and wing attachment brackets, aircraft wheel axle, and arresting hook). I.v.L.

N64-28265* National Aeronautics and Space Administration, Washington, D.C.
A REVIEW OF STRUCTURAL FATIGUE WORK IN THE U.S.A.
W. B. Miller and H. F. Hardrath (AFSC) *In* Italy. Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 171–195 refs (See N64-28257 20-33)

This review of structural fatigue work covers the following areas: (1) fundamental fatigue research; (2) crack propagation and residual strength; (3) cumulative damage in fatigue; and (4) full-scale aircraft systems. I.v.L.

N64-28266 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
REVIEW OF INVESTIGATIONS ON FATIGUE IN THE NETHERLANDS
A. Hartman *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 199–213 refs (See N64-28257 20-33)

Fatigue investigations are reviewed under the following headings: (1) riveted aluminum-alloy specimens; (2) adhesive-bonded aluminum-alloy specimens; (3) aluminum-alloy lugs; (4) the growth of fatigue cracks in aluminum-alloy specimens; and (5) cyclic creep and fatigue of PH stainless steel. I.v.L.

N64-28267 Laboratorium fur Betriebsfestigreit, Darmstadt (W. Germany)
REVIEW OF INVESTIGATION ON AERONAUTICAL FATIGUE IN THE FEDERAL REPUBLIC OF GERMANY, APRIL 1961 TO MARCH 1963
E. Gassner *In* Italy Min. Difesa Aeron. Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 215–260 refs (See N64-28257 20-33)

Investigations discussed are these: (1) flight-load measurements and related problems—the stress spectrum for the tension spar boom of the Viscount 814 and the cabin differential pressure spectrum for Viscount aircraft; (2) fatigue tests on different rivet joints—constant-load amplitude tests on single-shear rivet joints of different types, loading program tests on single-shear joints, and the fatigue strength of double-shear Huck-bolt-joints; (3) fatigue tests with riveted cylinders under varying internal pressure (model of a pressurized cabin). (4) constant amplitude tests on bolts of ultra-high-strength steel and of titanium alloys; (5) loading program tests with notched specimens of Al-Cu-2-Mg; (6) the influence of the shape of the spectrum on the fatigue life and on the allowable stress of a welded joint; (7) the effect of superimposed stress amplitudes on fatigue life (two-step tests with notched specimens of CK 35); (8) loading program tests with a complete and a truncated wing-load spectrum; (9) the influence of grain direction on the fatigue strength of Al-Cu-4Si-Mn-Mg forgings; (10) basic investigations to establish design rules for airframe and landing-gear parts; and (11) loading program tests on a wing attachment (bolted joint of Al-Cu-2-Mg). I.v.L.

N64-28268 Italy Ministero Difesa Aeronautica, Rome
REVIEW OF RECENT FATIGUE WORK IN ITALY
V. Villa *In its* Minutes of the 8th Conf. of the Intern. Comm. on Aeron. Fatigue [1963] p 261–269 (See N64-28257 20-33)

The activities of the laboratory in the field of fatigue were almost entirely absorbed by work of an applied nature connected with the operation of military and civil aircraft. The following activities are described: (1) load spectra determination through fatigue meters on fighter, trainers, and military transport aircraft; (2) full-scale fatigue testing on components and on complete aircraft structure; (3) the subjection of three wings of a trainer of obsolete type to fatigue tests to determine the crack propagation in different spots of the wing; (4) an investigation of crack propagation on steel plates subjected to direct stress; (5) the conduction resonance, constant amplitude, and fatigue tests at two or three levels, or using a standard incremental law, on compressor blades at 20° and 150° C; (6) an investigation of the fatigue behavior of the T-6Al-4V alloy at low and elevated temperatures; and (7) an investigation of steel standard specimens subjected to fatigue tests under direct stress. I.v.L.

N64-28286 Southwest Research Inst., San Antonio, Tex.
VIBRATION CHARACTERISTICS OF THREE REPRESENTATIVE HYDROFOIL CONFIGURATIONS Final Report
Kishor D. Doshi and Guido E. Ransleben, Jr. Dec. 1963 113 p refs
(Contract NObs-88114(X))
(AD-602544)

Comparisons are made between theoretical and measured resonant frequencies for three representative hydrofoil configurations (Inverted Pi, Vee, and Inverted Tee), with variable end conditions and depth of submergence in water. Theoretical calculations were based on influence coefficients, accounting for the apparent mass effect of the water. Agreement on frequencies through the first six to eight modes of vibration for all configurations is generally excellent, being well within 10% in most instances and in no case greater than 18.1%. Agreement on mode shapes is also generally good. Author

N64-28319* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY RESULTS OF COMPRESSION TESTS ON CYLINDERS WITH ECCENTRIC LONGITUDINAL STIFFENERS
Michael F. Card Washington, NASA, Sep. 1964 17 p refs
(NASA-TM-X-1004) OTS: $0.50

Preliminary results from an experimental study of the effect of stiffener eccentricity on the buckling load for cylinders loaded in compression are reported. The results of buckling tests conducted on four integrally stiffened cylinders and two Z-stiffened cylinders are presented. The tests reveal that an externally stiffened cylinder may carry over twice the load sustained by its internally stiffened counterpart. Available shell-buckling solutions have suggested this phenomenon, but are not adequate for predicting the experimental results because of differences between the boundary conditions at the ends of the cylinders considered in the solutions and those of the experimental cylinders discussed herein. Author

N64-28331* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF AN ENERGY METHOD USING FINITE DIFFERENCES FOR DETERMINING THERMAL MIDPLANE STRESSES IN PLATES
Harry G. Schaeffer and Walter L. Heard, Jr. Washington, NASA, Aug. 1964 33 p refs
(NASA-TN-D-2439) OTS: $1.00

A method of obtaining a set of finite-difference expressions for the thermal stress function directly from the complementary strain-energy expression is evaluated. The essential difference between this method and the more usual partial-differential-equation approach is that, in the energy approach, only conditions involving the variation of the stress function and its first normal derivative at the boundary must be satisfied explicitly.

These conditions are generally termed the "geometric" boundary conditions. In approaching the problem from the partial-differential-equation viewpoint, rather than from the energy viewpoint, it is necessary to satisfy explicitly additional conditions involving the second and third derivatives, which are generally termed "natural" boundary conditions. Author

N64-28336* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BEHAVIOR OF A FLAT STRETCHED MEMBRANE WRINKLED BY THE ROTATION OF AN ATTACHED HUB
Martin M. Mikulas, Jr., (M.S. Thesis) Washington, NASA, Sep. 1964, 32 p refs
(NASA-TN-D-2456) OTS: $0.75

Analysis and experiment are presented for the wrinkling behavior or stretched membranes subject to a torque loading through an attached hub. The analysis makes use of a theory for partly wrinkled membranes that is based on a study of average deformations in the wrinkled region. Closed-form solutions are obtained for several different boundary conditions, and results are given in the form of torque-rotation plots. Experimental results from tests on thin sheets of plastic film were found to be in very good agreement with theory. Author

N64-28479 Joint Publications Research Service, Washington, D.C.
LIMITING EQUILIBRIUM OF A LOOSE MEDIUM WITH VARIABLE WEIGHT
V. V. Sokolovskiy *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 146–167 ref (See N64-28469 20-01) OTS: $7.00

This work is an analysis of equations of the flat limiting equilibrium of a loose medium, the volumetric weight of which is a function of mean pressure. Differential equations of characteristics with functions in a determined state have combinations that can be integrated, except when the volumetric weight is constant. This work considers the form of stable banks and pressure exerted on supporting walls. Solutions of these problems have a closed form, whereas solutions with constant volumetric weight can only be found numerically. Author

N64-28480 Joint Publications Research Service, Washington, D.C.
STABLE SHAPE OF A LOOSE MEDIUM NEAR A RIGID DIE
S. Yu. Karinskiy *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 168–189 refs (See N64-28469 20-01) OTS: $7.00

This work analyzes the flat limiting equilibrium of a loose body bound by a free contour, which has a curve of stress break. An approximate method is devised for solving a basic system of equations within the proximity of the characteristic. Numerical methods for determination of the line of stress break are introduced. Author

N64-28481 Joint Publications Research Service, Washington, D.C.
METHODS OF INVESTIGATING ELASTIC PLATE VIBRATIONS
L. Ya. Aynola *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 190–207 refs (See N64-28469 20-01) OTS: $7.00

This work applies the method of approximate division of variables for analysis of vibrating plates. This method combines Ritz's variation method with V. V. Bolotin's asymptote method. Author

N64-28482 Joint Publications Research Service, Washington, D.C.
AXIALLY SYMMETRIC OSCILLATIONS OF CYLINDRICAL SHELLS IN SUPERSONIC FLOW OF GAS
K. K. Livanov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 208–223 refs (See N64-28469 20-01) OTS: $7.00

Presented is a method for investigating axially symmetric oscillations of cylindrical shells, making it possible to obtain an accurate solution of problems considering forces of inertia of all displacements. The method is discussed in reference to the general equations of shell theory. Author

N64-28483 Joint Publications Research Service, Washington, D.C.
CONTACT PROBLEM OF TOROIDAL SHELL AND ANNULAR PLATE COUPLING
A. N. Volkov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 224–234 refs (See N64-28469 20-01) OTS: $7.00

An analysis is presented of a system of equations expressing conditions for contact of an annular plate with a toroidal shell, and boundary conditions in connection with the design of crimped shells for bellows are described. Author

N64-28484 Joint Publications Research Service, Washington, D.C.
ON SOME UNCONSTRAINED TWIST PROBLEM
Yu. A. Amenzade *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 235–257 refs (See N64-28469 20-01) OTS: $7.00

It is demonstrated that the determination of a stress condition from deformation due to unconstrained twisting of a bar, in the case where the deformation of the bar is restricted to a given circumference, can be reduced to a determination of function $F_1(z)$ of a complex variable z within the zone S in the plane $z = x + iy$. The bar approximates a rectilinear square whose center is at a certain distance from the center of the circumference, and the offset of the center of torsion from the center of the circumference is calculated. M.P.G.

N64-28485 Joint Publications Research Service, Washington, D.C.
ON STATIC STRESS CALCULATION OF GEAR WHEEL TEETH
A. G. Ugodchikov and A. M. Kuznetsov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 258–270 refs (See N64-28469 20-01) OTS: $7.00

The problem of stresses in a gear-wheel tooth acted upon by a force is solved by elasticity theory methods proposed by Muskhelishvili. The following assumptions are made: the problem is considered in one plane only; wheels are spur type and cylindrical; wheel thickness is constant; the contact between two teeth is along the entire length; and stress is evenly distributed. The necessary functions are derived by electrical modeling of conformal transformation. Numerical solution is possible in certain cases, and an example of one such case is given. M.P.G.

N64-28494 Joint Publications Research Service, Washington, D.C.
A COMPOSITE PROBLEM OF THEORY OF ELASTICITY FOR A LAYER
A. F. Khrustalev *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 348–353 refs (See N64-28469 20-01) OTS: $7.00

A solution to a problem of elasticity theory for an unlimited flat and parallel plane in space under given composite boundary conditions is presented. Equations for the general

solution of equilibrium, used in the form offered by Papkovich and Neyber, are used as an initial step for determining the stresses and displacements set forth in the problem. The problem is reduced to the determination of two harmonic functions that satisfy the initial boundary conditions. It is shown that Fredholm's integral equations of the first group, which correspond to the layer and to the half-space, can be solved by the approximate method of substituting finite systems of linear algebraic equations for integral equations.
M.P.G.

N64-28495 Joint Publications Research Service, Washington, D.C.
STRESSES AND DEFORMATIONS OF A PLATE MOUNTED ON A DEFORMED FOUNDATION
A. G. Bulavko *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 354–363 refs (See N64-28469 20-01) OTS: $7.00

The problem of stresses and deformations of a system in the form of an unbounded plate on a deformed base is useful when calculating foundation slabs, highway and airport surfacing, and similar constructions. A general solution of the problem is presented that is applicable to a wide variety of deformed foundations. The method provides direct expressions of stresses and strains for a system of plates on deformed foundations that are derived from known expressions for a foundation without a plate. It is assumed that the load is acting directly on the elastic or inelastic foundation and normal to the surface.
M.P.G.

N64-28496 Joint Publications Research Service, Washington, D.C.
BENDING OF A PLATE ON A COMBINED BASE
V. S. Koltsov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 364–373 refs (See N64-28469 20-01) OTS: $7.00

This work solves the problem of bending of a round plate and of an infinite strip, both being placed upon a combined base subjected to a symmetrical lateral load. Accepted in those solutions is I. Ya. Shtaerman's hypothesis of a generalized basis, which is a combination of Hertz's theory and the Tsimmerman–Vinkler hypothesis; A. G. Ishkova's method was used also
Author

N64-28497 Joint Publications Research Service, Washington, D.C.
PRESSURE FIELD DURING DIFFRACTION ABOUT A TRUNCATED WEDGE ZONE AND A HALF-INFINITE STRIP
D. Ye. Levit *In its* Eng. J., no. 2 1963 20 Aug. 1964 p 374–382 refs (See N64-28469 20-01) OTS: $7.00

This work uses the method of superposition to obtain formulas for determination of pressure fields during diffraction of a flat wave about a truncated wedge zone. The same formulas are applicable to determination of diffraction about a half-infinite strip, treating the problem as a special case. Calculations were completed, and curves were plotted showing an equal pressure in the case when the front of the wave is parallel to the side connecting the apexes. Diffraction about a truncated wedge zone is determined simply from solution of a problem related to a wedge.
Author

N64-28498 Joint Publications Research Service, Washington, D.C.
CREEP ON NON-FERROUS METALS AT ROOM TEMPERATURE BEYOND ELASTIC LIMITS
A. M. Zhukov *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 383–390 refs (See N64-28469 20-01) OTS: $7.00

The results of creep experiments at room temperature on three nonferrous metals—aluminum alloy D16T, magnesium alloy MA2, and brass—are presented. The measurements were made with a specially constructed mechanical tensiometer. The specimens were of round bar stock, and no thermal treatment was performed. Creep deformation was found to be significant (5% for MA2, 0.7% for D16T, and almost 3% for brass) and therefore cannot be disregarded in the theory of plasticity. Analysis of the results indicates that creep in metals at room temperature usually takes place under stresses exceeding the yield point. Circumstances that may invalidate this result are also discussed.
M.P.G.

N64-28499 Joint Publications Research Service, Washington, D.C.
CREEP AND DURABLE STRENGTH UNDER COMBINED TENSILE AND TORSIONAL STRESS
V. P. Sdobyrev *In its* Eng. J., No. 2, 1963 20 Aug. 1964 p 391–396 refs (See N64-28469 20-01) OTS: $7.00

The behavior of metals at high temperatures under combined stress conditions of tension and torsion was investigated to evaluate the creep theory hypothesis of proportionality of stress and strain deformation deviants. Hardened and tempered EI-787 alloy specimens were tested at 700° C for creep, until destruction. Analysis of the test results yielded the following conclusions: (1) Deviations from the hypothesis of proportionability by as much as ±40% were noted in some cases. (2) A satisfactory relationship between transformed stress and destructive time was established at the temperature of 700° C.
M.P.G.

N64-28521 Aeronautical Research Council (Gt. Brit.)
WIND-TUNNEL TECHNIQUES FOR THE MEASUREMENT OF OSCILLATORY DERIVATIVES
J. B. Bratt London, HMSO, 1963 54 p refs
(ARC-R&M-3319; replaces ARC-22146) HMSO: £1

Techniques for wind-tunnel measurement of oscillatory derivatives are grouped into two main categories–measurement-of-motion techniques and measurement-of-reaction techniques. The first category consists of free-motion techniques that apply to decaying oscillations and flutter oscillations and of excited-motion techniques that apply to elastic excitation, electrical excitation, and excitation with coupled freedoms. The second category pertains to free oscillations, external rigid drive, internal rigid drive, electrically excited oscillations, and pressure plotting. Associated instrumentation, such as displacement, force, and pressure pickups, as well as amplitude and phase measuring devices, is described. The suitability of the various techniques for different test conditions is discussed, and a brief reference is made to wind-tunnel effects on the measurements.
I.v.L.

N64-28522 France Ministere de l'Air, Paris
A THEORY OF PLANE ELASTICITY WITH REFERENCE TO SOME OBLIQUE AXES. PRACTICAL APPLICATIONS [THEORIE DE L'ELASTICITE PLANE RAPPORTEE A DES AXES OBLIQUES. APPLICATIONS PRATIQUES]
Francisque Salles Paris, Serv. de Doc. Sci. et Tech de l'Armement, Apr. 1964 76 p in FRENCH *Its* Publ. Sci. et Tech., N.T. 135

Included in this report are discussions of the following: (1) plane elasticity in oblique axes—the determination of displacements and the relationship between constraints and displacements, the derivation of the equation of compatibility, and the derivation of the formula for the energy of deformation; (2) the calculation of deformations in a plate with the shape of a parallelogram, both rigid and nonrigid plates (calculations essential

to the use of cambered wings); (3) the extension of the oblique plate to the method of finite differences; (4) the extension of the method of double columns to oblique, rigid plates; and (5) caissons made of oblique plates. I.v.L.

N64-28532 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
A PURELY OPTICAL METHOD FOR THE DIRECT MEASUREMENT OF MOMENTS IN THIN BENT PLATES
Henry Favre and Bernhard Gile 28 Jul. 1964 29 p refs Transl. into ENGLISH from Schweig. Bauz. (Zurich), v. 68, no. 19, 13 May 1950 p 253–267
(RSIC-237; AD-604329)

The main properties of the deformations and the stresses for a bent thin plate made of a homogeneous and isotropic material are reviewed. These properties for a plate made of two adherent layers of different materials are discussed. These are the plates that enable us to measure optically the moments of flection and torsion. The method of measuring is described. An application of the method to a square plate, resting on three points, and supporting a force applied at its center is given. Author

N64-28541 Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
INVESTIGATION OF THE MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS Quarterly Report, Mar. 1–May 31, 1964
G. C. English 6 Jul. 1964 44 p
(Contract NOw-64-0170-C)
(QR-2; AD-602120)

Cathodic protection studies on the samples of 2024 and 7075 alloy plate prepared to represent a range of susceptibility to stress corrosion were continued; the new anodic polarization technique described earlier was investigated further; the samples were examined metallographically with the electron microscope, using the thin foil transmission technique and with the light microscope; and magnetic susceptibility measurements were made. Author

N64-28543 Syracuse U., N.Y.
A STUDY OF THE EFFECT OF SUPERIMPOSED STRESS CONCENTRATIONS Technical Documentary Report, Apr. 1, 1963–Mar. 31, 1964
V. Weiss, A. Takimoto, and J. Sessler Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1964 41 p refs
(Contract AF 33(657)-11154)
(ML-TDR-64-144; AD-602825)

The effect of tensile stress fields due to holes, superimposed on the stress fields due to external notches, was investigated by means of photoelastic techniques and tensile fracture tests. A niobium oxide resin photoelastic material, CR-39, and the titanium alloy 2.5Al-16V, aged to a brittle condition, were used to construct simple model systems for these studies, as a first step to simulate a prototype ceramic material. For the model systems employed in the investigation, it was found that no significant degree of interaction occurred between the stress fields of holes and the stress field due to the notch. Although the holes produced considerable localized stress inhomogeneities, this effect did not extend to the root of the notch where the maximum stress was solely determined by the stress concentration factor of the notch. The results of the tensile fracture tests confirmed the stress field studies. Author

N64-28546 General Electric Co., Evendale, Ohio Advanced Engine and Technology Dept.
INFLUENCE OF STRESS CORROSION ON STRENGTH OF GLASS FIBERS
D. L. Hollinger, W. G. Kanetsky, and H. T. Plant 20 Jul. 1964 16 p
(Contract Nonr-4486(00)(X))
(BMPR-2; AD-603516)

A program of static fatigue tests on single filaments of E-glass is underway. Presently, tests at room temperature and normal humidity are nearly completed, and these data are being analyzed. Static fatigue, or delayed failure, occurs under such conditions at stress levels as low as 200,000 psi; and a fatigue limit, if existent, was not yet determined. Author

N64-28555 Harvard U., Cambridge, Mass. Engineering and Applied Physics Div.
THE EFFECT OF A RIVETED STRINGER ON THE STRESS IN A SHEET WITH A CRACK OR A CUTOUT
Joseph M. Bloom Jun. 1964 57 p refs
(Contract Nonr-1866(02))
(TR-20; AD-603693)

This report is concerned with a theoretical investigation into the effect of a rivet-attached stringer on the stress concentrations in a thin elastic sheet with a crack or a cutout. The sheet and stringer are loaded (at infinity) by a uniform tensile stress parallel to the stringer. The sheet contains a finite crack perpendicular to the stringer. The effect of the stringer on the stress concentration due to a circular cutout is also investigated. The problem is formulated in terms of an infinite set of algebraic equations for the unknown rivet loads that are truncated and then solved on the IBM 7094 digital computer. The results are used to calculate the effect of the stringer on the strength of the stress concentration at the crack tip and also at the edge of the circular cutout. Author

N64-28556 Harvard U., Cambridge, Mass Engineering and Applied Physics Div.
DYNAMIC BUCKLING OF IMPERFECTION-SENSITIVE STRUCTURES
Bernard Budiansky and John W. Hutchinson Jun. 1964 40 p
(Contract Nonr-1866(02))
(TR-18; HD-603691)

Elastic buckling under suddenly applied dead loads that are maintained at a constant magnitude is considered. Following a discussion of criteria for dynamic buckling, the implications of some simple imperfection-sensitive models are discussed. On the basis of Koiter's theory of postbuckling behavior, general approximate theories of dynamic buckling were formulated, and their relations to the simple models were studied. Analyses were made of the dynamic buckling (under suddenly applied axial loads) of circular cylindrical shells that were stiffened by longitudinal stringers as well as of shells that were unstiffened. R.T.K.

N64-28558 California U., Berkeley Inst. of Engineering Research
FREQUENCY EFFECTS IN PANEL FLUTTER OF CYLINDRICAL SHELLS
R. A. Brown and M. Holt Mar. 1964 22 p refs
(Grant AFOSR-268-64)
(AS-64-6; AD-603961)

The expression for the pressure coefficient on a vibrating cylindrical shell of finite length in unsteady supersonic flow is

simplifed. The expression is valid at high values of Mach number and is based on the quasi-steady approximation when only first-order terms in vibration frequency are considered. The kernel functions arising in the expression for the pressure coefficient are tabulated and shown graphically for a series of circumferential modes. Author

N64-28563 Harvard U., Cambridge, Mass. Engineering and Applied Physics Div.
TOROIDAL SHELL UNDER INTERNAL PRESSURE IN THE TRANSITION RANGE
John N. Rossettos and J. Lyell Sanders, Jr., Jun. 1964 55 p refs
(Contract Nonr-1866(02))
(TR-19; AD-603692)

For the circular toroidal shell under internal pressure, the solution of the linear membrane equations does not yield continuous displacements. This difficulty can be resolved by the use of either linear bending or nonlinear membrane theory, whichever is applicable. In the present paper, an analytic solution is found in a transition range where both bending and nonlinear membrane action must be considered simultaneously. The governing equations are reduced to two simultaneous equations, each containing a large parameter. Methods of asymptotic integration are then used, and the problem is finally reduced to solving four sets of two simultaneous, second-order linear differential equations whose solution depends on a transition parameter ρ. These equations are solved numerically for various values of ρ, and the resulting functions can be used to solve the problem for practical values of parameters in the transition range without the further need of a computer. Author

N64-28615 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE BEHAVIOR OF A PRESSURIZED CIRCULAR CYLINDRICAL MEMBRANE COLUMN UNDER COMBINED BENDING AND COMPRESSION. TECHNICAL REPORT: AEROSPACE SCIENCES
W. E. Jahsman Mar. 1964 31 p refs
(Rept.-6-90-63-114)

Load-lateral deflection curves are developed for a pressurized tube of circular cross-section under combined bending and compression. The tube walls are assumed to have negligible compressive strength so that wrinkling develops if the stress tends to become negative. For a given bending moment, the load increases monotonically with deflection until a maximum is reached beyond which the load decreases with increasing deflection. An interaction curve of the maximum load versus bending moment shows that the presence of only a small amount of bending significantly decreases the maximum compressive load below the classical Euler load. Conversely, for bending moments that produce almost complete wrinkling of the cross section, only very small amounts of compressive load can be supported. Author

N64-28660 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
FRACTURE STUDIES OF ZIRCALOY-2
R. G. Hoagland and A. L. Bement, Jr. 4 Jun. 1964 26 p refs
(Contract AT(45-1)-1350)
(HW-82631)

Slow bend tests on fatigue cracked beams indicate that Zircaloy-2 undergoes a ductile-to-brittle transition at about −130° C in the annealed condition. Cold rolling to 23% reduction in thickness results in a 60° C increase in the transition temperature, and a fortyfold increase in the crosshead speed of the testing machine causes a further increase of 30° C in the transition temperature. Charpy impact tests indicate a transition temperature about 500° C above the transition temperature for the fatigue cracked beams. However, Charpy specimens tested in slow bending undergo a transition about 100° C below the fatigue cracked beams indicating the combined effects of crack sharpness and loading rates on the transition temperature. Of three orientations examined in the annealed material, i.e., crack propagation parallel, transverse, and at 45° to the rolling direction, no distinct effect of anisotropy on the transition temperature was found. Fracture occurred with nearly the same ease in the parallel and transverse specimens, but was considerably more difficult for the 45° orientation. Optical metallography and electron microfractography were also performed. Author

N64-28747* Republic Aviation Corp., Farmingdale, N.Y. Applied Research Development
THE DETERMINATION OF THE NATURAL MODES OF VIBRATION FOR LARGE SYSTEMS Final Summary Report, 9 Apr.–9 Dec.1962
C. J. Meissner, R. S. Levy, S. Telles, and J. H. Berman [1962] 111 p refs
(Contract NAS8-2646)
(NASA-CR-58540; RAC-406-4) OTS: $9.60 ph

This report contains a method for obtaining the influence coefficients and natural modes of vibration for a complex structure. The flexibility matrix method is described for obtaining the influence coefficients of a complex structure. The advantage of this method is that large structures may be analyzed without the necessity of inverting large matrices. Lanczos' method for obtaining eigenvalues and eigenvectors of large matrices is described. This method has the ability to extract the eigenvalues and associated eigenvectors even when the eigenvalues are extremely close together or are in fact multiple, as well as when the eigenvalues cover a large spread. The digital computer program on the IBM 7090 computer is included. Author

N64-28793 Space Technology Labs., Inc., Redondo Beach, Calif. Mechanics Div.
AN ANALYSIS OF TRANSIENT PRESSURES DUE TO ROCKET SHUTDOWN IN A DUCTED UNDERGROUND LAUNCHER
C. N. Tsu 30 Jun. 1964 40 p refs
(Contract AF 04(694)-1)
(Rept.-6110-9487-RU-000; BSD-TDR-64-92; AD-602026)

This report presents a linearized analysis of the transient pressure phenomenon occurring in a ducted underground missile launcher of the Titan II type during the shutdown of rocket engines. Such a shutdown may take place during a captive test or an aborted launch. Comparisons of the analysis and test data are made, and the usefulness of the present analysis for predicting the shutdown transient pressures is demonstrated. Author

N64-28839* RAND Corp., Santa Monica, Calif.
ON THE FOUNDATIONS OF DYNAMICAL ANALYSES OF BOOST VEHICLES. II: THE INHOMOGENEOUS PROBLEM
Dominic G. B. Edelen Jun. 1964 30 p refs
(Contract NASr-21(03))
(NASA-CR-58357) OTS: $2.60 ph

Investigations to determine whether linearized analyses of boost vehicles provide acceptable predictive techniques for

determining the dynamical environment of the vehicle when the governing differential equations are nonlinear and driven by external (stochastic) excitations are reported. The analysis shows that no general procedure is acceptable in all cases, and that each particular design must be evaluated in its own right. The only present procedure by which confidence can be established in the design of boost vehicles under wind excitation is that of detailed digital simulation with the best available sample functions for the wind excitations. M.P.G.

N64-28852 Aeronautical Research Council (Gt. Brit.)
AEROELASTIC PROBLEMS OF HIGH SPEED AIRCRAFT
D. Moxon London, HMSO, 1964 36 p refs
(ARC-CP-668; supersedes RAE-STRUCT-221, ARC-19665)
HMSO: 7s

Aeroelastic calculations on a number of specific aircraft projects have recently been made to provide comparative assessments. The characteristics of the aircraft were such as to provide valuable data on the aeroelastic problems of future high speed aircraft with specific reference to wing planforms and foreplane control. The flutter, divergence, and aileron reversal speeds are given for the various projects, and general conclusions are drawn. Throughout the work simple arbitrary modes have been assumed, and simple beam theory was used in evaluating the elastic stiffnesses. Author

N64-28860 Aeronautical Research Council (Gt. Brit.)
FORCES ON TETHERED BALLISTIC MISSILES DUE TO MOTOR CUT-OFF—A THEORETICAL TREATMENT
D. Moxon London, HMSO, 1964 34 p
(ARC-CP-674 Replaces RAE-TN-STRUCT-282, ARC-22515)
HMSO: 6s 6d

Motor-running tests may be carried out on a ballistic missile while it is tethered to its launcher. When the motors are cut off the missile structure is excited in various vibration modes by the combined influence of the decaying thrust and the elastic force from the launcher. These vibrations result in loads on the missile that can exceed those encountered in normal flight. It is the magnitude of these loads and the parameters affecting them that are investigated in this paper. Presented are results obtained on the assumption that the missile itself is rigid, whereas the launcher structure is elastic: missile flexibility is taken into account. A high launcher stiffness and a low rate of thrust cutoff are found to be favorable. The effect of fuel load is studied briefly: as the fuel load decreases, the overall forces decrease. Author

N64-28883* Exotech Inc., Alexandria, Va.
INVESTIGATION OF A MICROMETEOROID VEHICLE DAMAGE ASSESSMENT SYSTEM Summary Report
W. C. Coolev and P. G. Luckhardt 19 Nov. 1962 77p refs
(Contract Nas8-5033)
(NASA CR-58528) OTS: $7.60 ph

Experimental and analytical studies have been conducted leading to design specifications for micrometeoroid penetration detection systems based on the detection of infrared or visible radiation inside a space vehicle. Micrometeoroid impact simulation was achieved in a hypervelocity facility utilizing a powder gun and producing impact velocities in excess of 7,500 fps. Analytical studies were conducted to determine the optimum design for optical and sensor systems for use in space vehicle propellant tanks. The analysis of sensor requirements included theoretical and experimental studies of the characteristics of infrared and visible radiation produced behind a wall by penetrating impacts. Author

N64-28912 Florida U., Gainesville Engineering and Industrial Experiment Station
RESPONSE OF A NONLINEAR BEAM TO RANDOM EXCITATION
Richard E. Herbert May 1964 24 p refs
(Grant AF-AFOSR-62-313)
(AFOSR-64-0886; AD-444475)

The theory of the Markoff process and the associated Fokker–Planck equation is used to investigate the large vibrations of a hinged, axially restrained, elastic beam driven by white noise. An expression for the joint probability density function of the first N modal amplitudes is obtained and used to derive an approximate expression for the mean squared response. Numerical integration of the exact expression for the mean squared displacement of the beam has shown a reduction of this quantity as compared to the linear theory. Calculations have also shown a limited range of applicability of the approximate formula. Furthermore, it was shown that the first mode still gives a good estimate of the mean squared response, but the coupling effect of the modes is so important for sufficiently large deflections that the effect of the higher modes must be taken into account when computing the mean squared value of the first mode. Author

N64-28914 Northrop Corp., Hawthorne, Calif.
SIMULTANEOUS APPLICATION OF STATIC AND DYNAMIC LOADS ON SONIC FATIGUE TEST ARTICLES Technical Documentary Report, Jun. 1962–Jun. 1963
W. H. Roberts and D. P. Wilhem Wright-Patterson AFB, Ohio, RTD, Jun. 1964 111p refs
(Contract AF 33(657)-8759)
(RTD-TDR-63-4021; AD-604407)

With the existence of the RTD sonic test facility, it becomes necessary to investigate the requirements for reliability fatigue testing during the simulated application of static, dynamic, and acoustic service loadings. This report includes the findings of an extensive investigation of previous combined load failures, documents the existence of such failures, and suggests possible future problems based on an industry-wide survey of actual case histories. Analytical substantiation of the increased probability of failure and theoretical acoustic considerations are presented to indicate that combined loads do present a particular problem area. The simulation of static, dynamic, and acoustic loads is discussed in terms of general principles that must be taken into consideration and general testing methods applicable to difficult and costly vehicle fatigue problems. Author

N64-28980 National Aeronautical Lab., Bangalore (India)
VIBRATION STUDIES ON THE NAL COMPRESSOR FOUNDATION STRUCTURE
M. L. R. Murthy, B. R. Somashekar, B. S. Dasannacharya, J. R. Cole, and Y. V. G. Acharya Dec. 1963 67 p refs
(NAL-TN-AE-22-63)

The results of model studies and theoretical analysis of the natural frequencies of vibration of the NAL compressor foundation structure are presented. The design of machine foundations in general and of fundations for rotating machines in particular has been studied, and the methods and materials used for isolating the surrounding area from the residual vibrations are discussed. It has been observed that the natural frequencies of the foundation structure designed for the NAL compressors are far removed from the operating frequencies of the machine components it supports and that there is no likelihood of any resonance. Author

N64-28985* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HYPERVELOCITY IMPACT DAMAGE CHARACTERISTICS IN ARMORED SPACE RADIATOR TUBES
Seymour Lieblein, Nestor Clough, and A. R. Mc Millan (Gen. Motors Corp.) Washington, NASA, Sep. 1964 44 p refs
(NASA-TN-D-2472) OTS: $1.25

Described are the results of an exploratory experimental research program to determine the damage that might be inflicted on space radiator configurations by the impact of a meteoroid. The meteoroid hazard is discussed, and the present knowledge of crater formation under conditions of hypervelocity impact is analyzed. Glass projectiles of approximately 0.016 and 0.040 gram were accelerated to velocities of 23,000 to 26,000 fps and impacted against unfilled radiator tube configurations in vacuum. Variables such as tube liner thickness, tube inner diameter, armor thickness, operating temperature, and angle of impact were considered for aluminum and columbium alloy targets. Significant differences between hypervelocity impact into flat plates and into aluminum and columbium tubes were observed. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-28004 Martin Co., Baltimore, Md. Baltimore Div.
AXISYMMETRICAL LARGE DEFLECTION ANALYSIS OF TANK JUNCTIONS
Carl G. Swanson Jun. 1964 61 p refs
(RR-51)

The junction analysis for the intersection of a tank wall, tank dome, and skirt structure, such as is found in rocket-propelled booster vehicles, is formulated. Large deflection influence coefficients for use in the analysis are given. Examples showing the effect of various factors in the analysis have been worked out. Author

N64-28118 Republic Aviation Corp., Farmingdale, N.Y.
A LINEARIZED LARGE DEFORMATION THEORY FOR ROTATIONALLY SYMMETRIC MEMBRANES
Martin A. Goldberg 19 Mar. 1964 21 p refs
(RAC-2236)

A linearized large deformation analysis for initially curved, rotationally symmetric membranes is developed. Starting with Marguerre's shallow membrane equations, and under conditions associated with the existence of a boundary-layer phenomenon, the controlling nonlinear stress function equation is reduced to a second-order linear differential equation. The order of the equation is sufficient to permit satisfaction of physically realizable boundary conditions. The linearized stress function equation is employed to investigate an internally pressurized spherical cap and a complete cone. Numerical computations are presented for each problem, along with solutions to the original nonlinear equation. Agreement between these results is shown to be very good. A comparison of the linearized solutions with the more accurate nonlinear results indicates that the nonlinear solutions are asymptotic to the linearized results. Author

N64-28123 Nourse (J.H.)
A REVIEW OF THE TECHNICAL LITERATURE FOR THE ELASTIC ANALYSIS OF FILAMENT-WOUND PRESSURE VESSELS
J. L. Amick and J. H. Nourse Jul. 1964 26 p refs
(Sponsored by Hercules Powder Co.)
(Rept.-1)

In the elastic analysis of filament-wound pressure vessels, the contribution of the resin to the strength of the composite is considered, and the resin is treated as an elastic solid. The following aspects of elastic analysis are discussed: (1) longitudinal, transverse, and shear moduli of parallel-filament composites; (2) moduli of symmetrical filament-wound composites; and (3) design of pressure vessels. E.K.R.

N64-28200 Emerson and Cuming, Inc., Canton, Mass.
DESIGN TECHNIQUES FOR STRUCTURALLY SUPPORTED RADOMES Interim Engineering Report, 27 Apr.–27 Jul. 1964
Russell Stetson, Eino J. Luoma, and Samuel J. Mason, (MIT) 1 Aug. 1964 30 p
(Contract AF 33(615)-1376)
(IER-2; AD-444421)

Debugging is complete on a first FORTRAN program for predicting plane wave transmission performance of a space frame. Results of the first program are plotted and shown to agree with experimental data. In experimental work the flat grid test setup was revised for better illumination without edge effects. Test procedure and test results are presented. Design limits were established for stagnation pressure, stagnation temperature and its rate of rise, and yaw. Author

N64-28303 Lockheed-Georgia Co., Marietta Scientific and Technical Information Dept.
BIBLIOGRAPHY ON AERONAUTICAL WEIGHT ESTIMATION AND CONTROL [1957–MAR. 1964]
C. D. Rife, comp. 1 Aug. 1964 19 p refs

N64-28703 Goodrich (B.F.) Co., Akron, Ohio Aerospace and Defense Products
PRESSURIZED BOW DOME OF A CABLE-REINFORCED RUBBER CONSTRUCTION FOR USE WITH AN/SQS-26 SONAR Monthly Summary Report, Mar. 31–Apr. 30, 1964
R. D. Tubaugh 30 Apr. 1964 14 p
(Contract NObsr-89483)
(Rept.-12; AD-443882)

The prototype panel hydrostatic test fixture was installed and mounted, and several tests were completed, including pressurization to 40 psi and 80 psi. An investigation into the decay rate of waves that may be induced into the window was made through experimentation on the prototype panel. Results indicate that the cable-reinforced rubber window is far superior to the steel dome with respect to self-damping characteristics. Utilization of the DTMB computer program "Three Dimensional Potential Flow" for determining the cavitation characteristics of bodies in water was tested successfully using the DL-5 acoustic window contour coordinates. Author

N64-28746* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FORMING OF INTEGRAL RIBS BY COLD PRESS-EXTRUSION TECHNIQUES
P. H. Schuerer and P. R. Bradie 5 Jun. 1964 39 p
(NASA-TM-X-53058) OTS: $3.60 ph

This report covers the theory involved, the actual techniques employed a general description of equipment and materials used, and the initial results of a pilot operation to prove the feasibility of forming fully developed integral ribs by means of cold press-extrusion techniques. The panels so formed exhibit properties equivalent to those of the desired alloy and temper. The lines of grain flow are smooth and uninterrupted, so it is expected that ultimate strength, fatigue resistance, and reliability should be superior to waffled panels formed by such conventional methods as chemical or mechanical milling. A great amount of research and development work still needs to be done in forming full size panels with rib spacing up to 27 in. A major area of difficulty will be the control of skin thickness (panel flats) where waffled areas vary in size. Also, further work is required to optimize the sequence of operations in forming waffled panels. Author

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